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VERIFY THE PERSONAL ORAL HYGIENE  
REQUIREMENTS FOR EXTENDED MANNED SPACE  
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ANNUAL REPORT  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Contract No. NAS 9-11118

July 1, 1971 through June 30, 1972

TITLE: STUDY TO DEFINE AND VERIFY THE PERSONAL  
ORAL HYGIENE REQUIREMENTS FOR EXTENDED  
MANNED SPACE FLIGHT

by

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## PREFACE

This is the fourth annual progress report of the project entitled "Study to Define and Verify the Personal Oral Hygiene Requirements for Extended Manned Space Flight."

This report is divided into five parts consisting of: 1) effects of a simulated spacecraft environment on the oral microflora of non-human primates, 2) the oral microbial profile of the marmoset, 3) effects of immunosuppression, antibiotics and protected environments on the human oral microflora, 4) effectiveness of chemically impregnated paper wipes in decontaminating dental instruments, and 5) a literature review of prevention and control of dental disease. This report thereby concludes all of the preliminary objectives of the project pertaining to: a) the establishment of adequate and practical sampling methods for a microbial census of the intraoral tissues of humans and subhuman primates, b) the fabrication of a hypobaric pressure chamber suitable for housing marmosets in a simulated spacecraft environment, c) the determination of the effects of simulated spacecraft environment on the oral microflora of subhuman primates, d) the effect of different dietary regimens on the oral microflora of marmosets, e) the comparableness of the oral microflora of marmosets and humans, f) the establishment of a baseline census of the culturable oral microorganisms of humans under conventional and nonconventional environments, g) the evaluation of chemically saturated wipes in

removing bacterial contamination from dental instruments, and h) a literature review on the prevention and control of dental disease.

The results contained in this and previous annual reports constitute a necessary and logical progression toward the attainment of the primary goal of defining the oral hygiene requirements for humans in prolonged space missions and to establish practical and adequate means of preventing oral health hazards under such conditions. All future research in this area will involve humans exposed to space or land based space simulators for extended periods of time.

The principal investigators wish to express their gratitude to Lt. Colonel William J. Frome, DC, USAF, Project Officer, for his advice and guidance during the past four years. The investigators would also like to acknowledge Mrs. Sandra Allen for her continuous technical assistance through all phases of the project, Dr. Dennis Johnston, Consultant, The University of Texas M. D. Anderson Hospital and Tumor Institute for statistical analyses, Dr. Samuel Dreizen for editorial suggestions, Miss Barbara Hellmers for preparation of all illustrations and Mrs. Mary Fuller and Mrs. Virginia Sappington for secretarial assistance. Other persons who contributed greatly to specific studies of the project are acknowledged in the sections of this report in which they participated.



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## PART I

### Effects of a Simulated Spacecraft Environment on the Oral Microflora of Nonhuman Primates

Extended space travel will soon be a reality since a 56 day Skylab mission has already been scheduled. To insure the unqualified success of such ventures, all possible health hazards must be eliminated. The oral tissues are particularly vulnerable to stress and systemic disease and can play an important role in disease transmission. Impairments to oral health in the form of infectious lesions, ulcerations, periodontal disease or dental caries would be extremely detrimental to the performance of personnel confined to space capsules.

To gain some insight into the effects of a simulated spacecraft environment on the oral microflora, studies were made using the marmoset (Sanguinus oedipus) as the test animal. Marmosets were selected because they are the smallest of the primates and the easiest to handle and maintain.<sup>1-3</sup> Their mouth structures and oral disease symptoms are similar to those of man.<sup>4-9</sup>

The primary purpose of this study was to determine whether a simulated spacecraft environment would induce qualitative and/or quantitative alterations in those oral microorganisms which have disease-producing potential. This report includes the cumulative results from nine chamber trials involving 18 animals during 14, 28, and 56 day chamber isolations.

### Materials and Methods

A high altitude chamber 18" in diameter and 36" in length was fabricated from acrylic plastic to house two marmosets simultaneously in separate compartments. The chamber was designed to reproduce a spacecraft environment by maintaining a 70% level of oxygen and 30% level of nitrogen at a pressure one-third of normal atmosphere (5PSI). A recirculation system and chemicals were used to remove moisture, carbon dioxide, and other waste products from the chamber's atmosphere. Pure oxygen was added automatically to replenish that used by the animals. Details concerning the fabrication and operation of this hypobaric unit have been previously described by Brown, et al. 8-10

Sublingual residual saliva, gingival crevicular fluid and swabs of the oral surfaces were taken from the paired animals at regular intervals before, during, and after each of the 14, 28, and 56 day chamber trials. Residual saliva was collected from under the tongue with a 2 mm diameter wire loop, crevicular fluid was obtained by the complete insertion of a 3 mm endodontic paper point into the gingival sulcus of a maxillary premolar, and the surfaces of the teeth and soft oral tissues were sampled with a calgiswab. Specimens were collected from each animal four times during a two-week period prior to chamber isolation, once a week during isolation, and four times beginning two to four days after removal from the chamber. In addition to the microbial sampling, all animals were weighed immediately before being placed in the chamber, once weekly

while in the chamber and one week after removal from the chamber.

All samples were placed in 2 ml of 0.1 per cent peptone in normal saline solution and suspended with the aid of glass beads by 30 seconds of vigorous shaking by hand, and 15 minutes on a Vortex shaker.\*

Aliquots of each sample suspension were serially diluted and plated onto media for the numerical assessment of various microbial categories as described by Brown, et al.<sup>8-10</sup> All numerical estimates were made manually and/or electronically\*\* from duplicate countable plates and recorded for a programmed computer analysis.

### Results

Fourteen, 28, and 56 day chamber isolations were repeated three times using pairs of animals in each of the nine trials. The animals adapted to the chamber rather easily and were maintained in the simulated spacecraft environment with few problems except for weight loss and diarrhea. The weight losses (Fig. 1) occurred in 16 of the 18 animals and were independent of the diarrhea. Usually only one of the two marmosets developed diarrhea which always followed the initial weight loss. The specific cause(s) of diarrhea which is exceedingly common in captive marmosets irrespective of environment or diet was not delineated in this study. Assessments of the stool microflora in animals with diarrhea

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\*Vortex shaker Model #K-550-G available from Scientific Instruments, Inc., Springfield, Massachusetts.

\*\*Petri Scan Model #5-7250 available from American Instrument Co., Inc., Silver Spring, Maryland.

revealed no qualitative or quantitative differences from animals with normal stools except for evaluations in number of Escherichia. Random Escherichia coli isolates were not found to be enteropathogenic by serotyping.

The  $\log_{10}$  means of the cumulative counts of predominant oral microflora cultured from residual (loop collected) saliva before, during, and after chamber isolations are presented in Fig. 2. An analysis of variance disclosed a significant increase ( $P=.002$ ) in total anaerobes during the 56 day chamber isolations. This difference was primarily due to a cycling of counts at the first and sixth week of chamber isolations and did not represent an overall trend. To normalize the data, a square root transformation was performed on representative counts, but the effect on the F ratios was minimal.

Comparison of the  $\log_{10}$  means of cumulative counts of the predominant oral microflora recovered from crevicular fluid before, during and after chamber isolation (Fig. 3) showed patterns similar to those from residual saliva. Contrary to the latter, data analyses revealed significant increases in fusobacteria ( $P=.008$ ) and bacteroides ( $P=.01$ ) in the crevicular fluid sample during the 28 day chamber trial. The significant increases were transient and occurred in only two of the six animals.

In-chamber counts from oral swabs showed transient increases in streptococci ( $P=.002$ ) at the end of the 14 day trials and in staphylococci ( $P=.05$ ) at the end of the 28 day isolations (Fig. 4). In each instance, the

increases were mainly attributable to individual animals rather than to the entire group. The oral swab sampling procedures permitted the assessment of more microbial categories than either the loop collected saliva or paper point collection of crevicular fluid. This was ascribable to both sample size and microbial concentrations.

Some of the chamber-associated, animal-related oral increases are exemplified by comparative counts of specific organisms plotted against time of chamber isolation (Fig. 5). Pronounced cycling was frequent and random with regard to animal, period of chamber isolation, and type of microorganism. This is further demonstrated in Table 1 which summarizes the statistics of the data which proved to be significantly different.

### Discussion

This study shows that the marmosets readily adapted to a simulated spacecraft environment for as long as 56 days without pernicious effects. Although persistent weight loss and diarrhea were observed, no other health impairments were apparent. There was no evidence of deleterious changes in the oral tissues and no indication of disease transmission between chamber-paired animals by oral exchange of microorganisms or by symptom complex.

The specific causes of weight loss and diarrhea were not elucidated in this study. The most pronounced weight losses were observed in the first 14 day chamber trials concurrent with an excessive, intermittent

noise level produced by an oxygen valve. The valve was later modified to suppress the noise which conceivably could have created undue stress in the normally high spirited marmosets. This attempt to prevent weight loss was followed by pre-isolation conditioning of the animals to the chamber. Neither noise suppression nor conditioning seemed to have any effect on weight responses during subsequent chamber trials. Comparisons of the amount of food and water intake of animals inside and outside of the chamber environment did not account for the weight losses. Furthermore this problem could not be related to the diarrhea since the weight losses always preceded diarrhea and frequently occurred in the absence of diarrhea.

There were no noteworthy qualitative changes in the oral microflora attributable to the chamber environment. Conversely, there were some chamber-associated, quantitative, microbial differences. These, however, appeared to be animal-related rather than group-related. Most of the statistically significant differences in microbial counts during chamber trials resulted from microbial increases in only a few animals within the group and/or from transient or cycling behavior rather than from an overall count trend. Increased counts were widely distributed among organism type, sample type, and chamber trial.

On the basis of this study, there are no predictable health hazards which might originate from the oral cavity during prolonged space flights. The inherent difficulty of attempting to accurately relate the information



gained from one animal species to another is well known and cannot be over emphasized. To overcome a food contamination problem, it was necessary to use a hard, dry diet which contained less carbohydrate than the human diet used in space flights. This difference could be extremely important regarding oral microbial changes and subsequent dental problems. Accordingly, the possible alteration of the sucrose content of the space diet should be considered. The forthcoming Skylab Medical Experiments Altitude Test should provide the necessary information concerning dietary influences on the human oral microbial responses to prolonged space flight conditions.

#### Conclusions

Marmosets adjusted to a space simulated environment rather easily and were maintained in the environment for 56 days with no problems except for weight loss and diarrhea.

There were no apparent environment-associated changes in the oral tissues and no noteworthy qualitative alterations in the oral microflora. There were, however, environment-associated quantitative microbial changes which were animal-related rather than group-related. These changes primarily involved widely distributed increases in certain resident and transient oral microorganisms. There was no direct evidence of oral transmission of the microorganisms between pairs of chamber-housed animals.

### Acknowledgements

The investigators wish to acknowledge Miss Catherine Shea, Research Technician III, for her technical contributions throughout this study.

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TABLE 1

ANALYSIS OF VARIANCE: SUMMARY OF CHAMBER-ASSOCIATED  
INCREASES IN ORAL MICROBIAL COUNTS

Chamber Trials	Microbial Category	Oral Specimen	ANALYSIS OF VARIANCE				
			Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio P
14 DAY	Strepto-cocci	Oral Swab	Chamber	$6.6 \times 10^{12}$	3	$2.2 \times 10^{12}$	6.3 .002*
			Error	$9.9 \times 10^{12}$	28	$3.5 \times 10^{11}$	
			Totals	$1.6 \times 10^{13}$	31		
28 DAY	Staphylo-cocci	Oral Swab	Chamber	$1.1 \times 10^9$	5	$2.2 \times 10^8$	2.3 .05*
			Error	$6.5 \times 10^9$	66	$9.9 \times 10^7$	
			Totals	$7.6 \times 10^9$	71		
28 DAY	Fuso-bacteria	Crevicular Fluid	Chamber	$4.0 \times 10^{11}$	5	$8.0 \times 10^{10}$	3.4 .008**
			Error	$1.5 \times 10^{12}$	66	$2.3 \times 10^{10}$	
			Totals	$1.9 \times 10^{12}$	71		
28 DAY	Bacter-oides	Crevicular Fluid	Chamber	$4.1 \times 10^{11}$	5	$8.2 \times 10^{10}$	3.1 .01**
			Error	$1.7 \times 10^{12}$	66	$2.6 \times 10^{10}$	
			Totals	$2.1 \times 10^{12}$	71		
56 DAY	Total Anaerobes	Residual Saliva	Chamber	$1.9 \times 10^{10}$	9	$2.1 \times 10^9$	3.3 .002**
			Error	$5.6 \times 10^{10}$	86	$6.5 \times 10^8$	
			Totals	$7.5 \times 10^{10}$	95		

\* An estimate of effects showed resultant statistic due primarily to two animals within group.

\*\* An estimate of effects indicated a transient or cycling behavior rather than an overall trend.

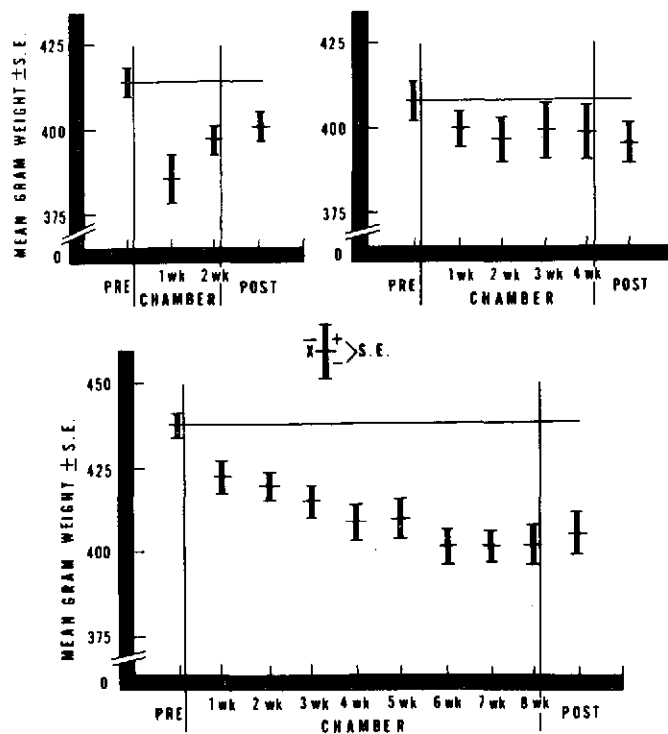


Fig. 1. Means and standard errors ( $n = 6$ ) of weight responses of marmosets before, during, and after chamber isolations.

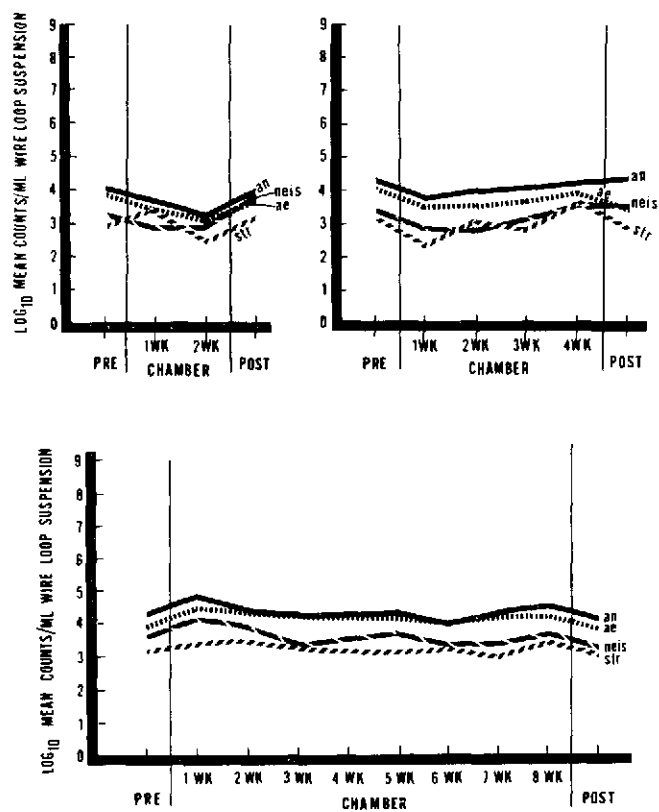


Fig. 2. Mean counts ( $n = 6$ ) of the predominant microflora cultured from the residual saliva of marmosets before, during, and after chamber isolations; an, total anaerobes, ae, total aerobes, neis, neisseria, str, streptococci.

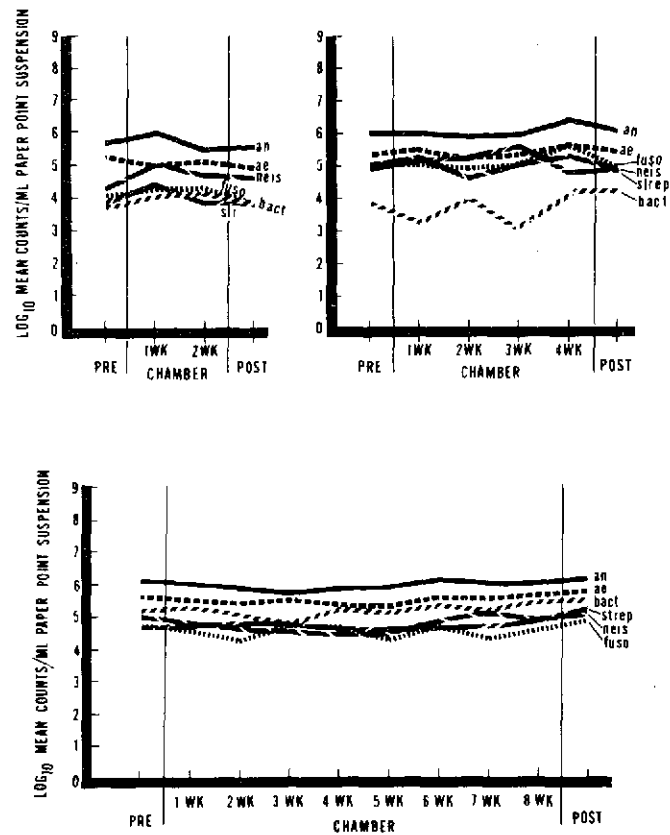


Fig. 3. Mean counts ( $n = 6$ ) of the predominant microflora cultured from the crevicular fluid of marmosets before, during, and after chamber isolations; an, total anaerobes, ae, total aerobes, neis, neisseria, fuso, fusobacteria, bact, bacteroides, str, streptococci.

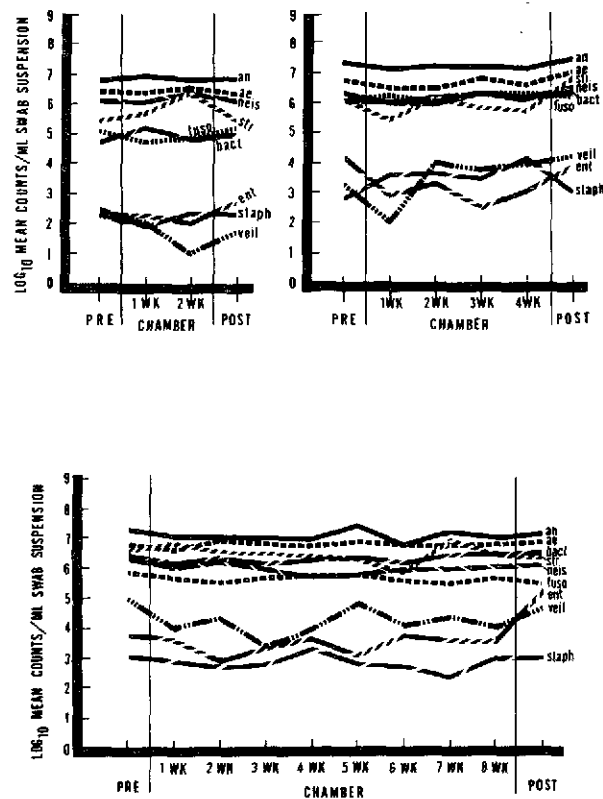


Fig. 4. Mean counts ( $n = 6$ ) of the predominant microflora cultured from oral swabs of marmosets before, during and after chamber isolations; an, total anaerobes, ae, total aerobes, neis, neisseria, str, streptococci, fuso, fusobacteria, bact, bacteroides, ent, enteric bacilli, staph, salt-tolerant staphylococci, veil, veillonella.



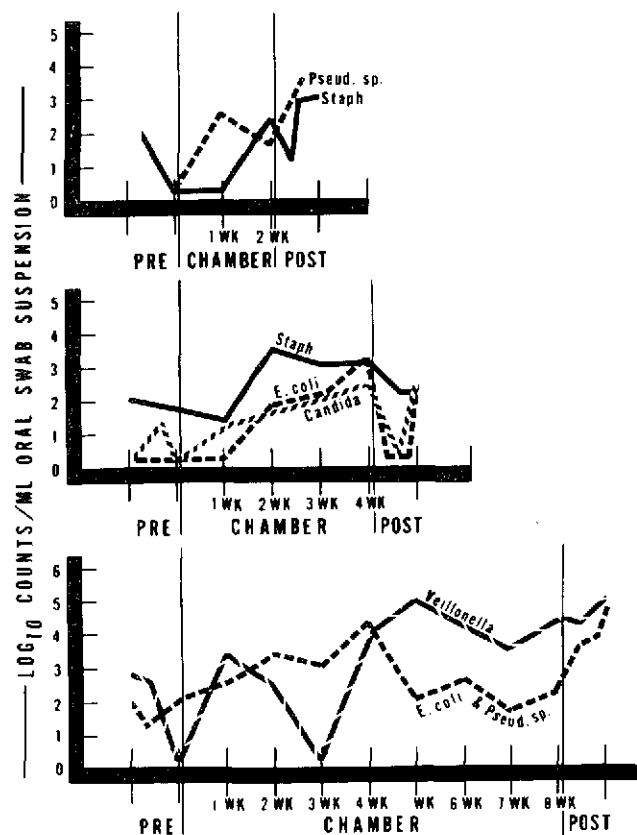


Fig. 5. Examples of chamber-associated, animal-related oral increases of microorganisms; *Pseud. sp.* a species of *Pseudomonas*, *Staph.* salt-tolerant staphylococci, *E. coli*, strains of *Escherichia coli*, *Candida*, species of *Candida*, *Veillonella*, species of *Veillonella*.

## PART II

### The Oral Microbial Profile of the Marmoset

The marmoset has proven to be a very valuable experimental model in many areas of biomedical research.<sup>1-5</sup> Several species of this small primate are rather inexpensively and easily colonized<sup>6-13</sup> and have an oral biology similar to man.<sup>14</sup> This has been well illustrated by an extensive periodontal biology study utilizing the marmoset as a model for human periodontal disease.<sup>15</sup> Although many biologic parameters have been established for this animal,<sup>16-28</sup> the marmoset oral microflora has received very limited attention other than a study of organisms isolated from throat swabs.<sup>29</sup>

As part of a program to determine the effects of space simulated environment on oral health,<sup>30</sup> the endogenous oral microflora of marmosets (Sanguinus oedipus) was studied under natural and stressed conditions. The present report includes cumulative qualitative and quantitative assessments of culturable oral microorganisms from conventionally housed marmosets on different dietary regimens. Comparisons between the human and marmoset oral microflora are also included.

### Materials and Methods

Numerical assessments were made twice weekly for four weeks of the culturable oral microorganisms from samples of residual saliva, crevicular fluid, and oral swabs. The sampling material consisted of 2 mm wire loops of sublingual residual saliva, 3 mm paper point saturations

of crevicular fluid and a swab of the hard and soft surfaces of the oral cavity. These samples were processed immediately after collection and plated on enrichment, differential and selective media incubated aerobically and anaerobically. The sampling and culturing techniques employed have been previously described by Brown, et al.<sup>30</sup> Standard bacteriologic identification procedures were used to classify the culturable oral microorganisms.

In addition to enumerating the general microbial categories found on the selective and differential media, the predominant organisms isolated on these media were characterized.

Samples of plaque and calculus accumulations from marmoset teeth were removed periodically with a dental scaler and examined under dark-field and phase contrast microscopy to check for microorganisms that were not being cultured.

Six animals were assessed on each of the following diets supplied ad libitum: (1) crushed hard dry Purina Monkey Chow,\* (2) soft moist ZuPreem Marmoset Diet,\*\* and (3) soft chemically defined high carbohydrate diet.<sup>31</sup> Qualitative and quantitative assessments of the culturable oral microorganisms from marmosets on the high carbohydrate diet were compared to those from humans.

### Results

A statistical analysis (one-way analysis of variance) showed many

\*Purina Monkey Chow, Ralston Purina Co., St. Louis, Missouri.

\*\*ZuPreem Marmoset Diet, Hill Packing Co., Topeka, Kansas.

diet associated significant differences in microbial counts from each type of oral sample (Table 1). Except for a few microbial categories in certain samples, these differences were caused by elevated counts in animals fed the high carbohydrate diet. In some instances counts from animals fed the hard, dry chow were higher than those from animals receiving the soft, moist diet. Counts of *Candida* were higher in animals receiving the soft, moist diet than in those fed the high carbohydrate diet (Table 1). Representative analyses of some of the highly significant and nonsignificant data are presented in Table 2.

Some of the predominant organisms which were subcultured for complete characterization were lost after initial isolation or would not grow in biochemical test media. Those isolates which were subcultured and identified or partially characterized are described in Tables 3 - 5. The identifiable isolates were dispersed among 12 recognized microbial families, 24 genera and more than 40 species (Table 3).

One of the most predominant groups of culturable oral microorganisms from marmosets were aerobic gram negative rods. Since identification attempts were unsuccessful the isolates were grouped according to fermentation patterns and categorized in Table 4. There were two apparent carbohydrate activity groups which were further divided into 14 subgroups based on other physiologic reactions and on cellular and colonial morphologic characteristics.

The remaining unidentified isolates consisted of gram positive rods

and gram positive and gram negative cocci and are miscellaneously grouped in Table 5. The most predominant and frequently isolated of these microorganisms were large gram negative cocci which occurred as either diplococci or tetrads (last isolate of gram negative cocci, Table 5). Upon initial isolation on aerobic blood agar the colonies were usually large, grey to white, irregular and wrinkled (Fig. 1a and 1b). Colonies initially isolated on anaerobic blood agar as well as subcultures from both aerobic and anaerobic blood agar were usually small, yellow, circular, entire, convex, and smooth (Fig. 1f). Variations in cell morphology involved changes between a diplococcal and a tetrad arrangement which was independent of colony morphology (Fig. 2). The organism was nonfermentative and gave variable reactions with catalase, oxidase and nitrate (Table 5).

In addition to cultured organisms, microscopic examinations of oral scrapings from marmosets revealed a variety of spirochetes and filamentous microorganisms in relatively high concentrations. Microfilaria were observed in one animal which appeared similar to the type previously reported in the oral structures of marmosets.<sup>32</sup>

Comparisons of count magnitude and variability of oral microorganisms between man and marmoset are exemplified by the predominant culturable organisms from the gingival sulcus of a maxillary premolar (Fig. 3). Counts were obtained from eight replica samples collected in an identical manner from one human and one marmoset. The

counts from the marmoset were 1.5 to 3.5 logs higher than those in the human, while variability, as reflected by the coefficients of variation, was relatively equal (Fig. 3). Similar findings were obtained from comparisons of counts from oral swabs and residual saliva samples from humans and marmosets. The count variability of these marmoset samples were less than those from humans.

### Discussion

In instances where there were significant dietary differences, the mean microbial count tended to increase as the level of carbohydrate in the diet increased; i. e., the high carbohydrate diet (approximately 60% sucrose) yielded significantly greater counts than the hard, dry diet which contained the second highest level of carbohydrate (approximately 49% utilizable). The soft, moist diet which contained the least amount of carbohydrate (approximately 29% utilizable) yielded the lowest microbial counts. The exception to this trend was in the counts of *Candida*.

An analysis of variance showed that due either to the equivalence of counts and/or variability within and among the marmosets, the Fusobacteria, Enterics and Lactobacilli categories from the oral swab samples were not diet associated. Residual saliva samples, which provided the smallest concentration and greatest variability of microorganisms showed few diet related count differences.

No attempts were made to classify the gram positive rods beyond placing them in the families Corynebacteriaceae and Actinomycetaceae

and noting some of their biochemical reactions, although they comprised a large portion of the predominant marmoset oral microflora.

The unidentified gram negative cocci appeared to belong to the genus Neisseria on the basis of cellular morphology, colonial morphology and oxidase reactions, but differed in catalase and/or nitrate reactions. The last isolate in this group (Table 5) together with the unidentified aerobic gram negative rod group constituted the largest portion of the most frequently isolated organisms from these marmosets. Although many different morphological types of these gram negative rods were isolated, the majority lacked the ability to ferment carbohydrates.

The marmoset and human oral microflora were found to be quite comparable with the exception of numbers of certain types of organisms. The most pronounced exceptions included the acidogenic and polysaccharide producing organisms which were isolated consistently in high numbers from man and inconsistently and/or in low numbers from marmosets.

### Conclusions

Adult marmosets (Sanguinus oepidus) were sampled for the qualitative and quantitative assessment of the culturable oral microflora while on three different dietary regimens: commercially available hard, dry monkey chow; soft, moist chow; and a biochemically defined high carbohydrate diet. Generally, higher counts of microorganisms were obtained from marmosets receiving the high carbohydrate diet indicating that the marmoset oral microflora is influenced by diet. The oral microflora of marmosets,

especially those fed a high carbohydrate diet, closely paralleled that of humans.

#### Acknowledgements

The investigators wish to acknowledge Mrs. Sandra Handler, Research Technician III, for her technical assistance during this study.



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Table 1

Microbial Counts<sup>1</sup> from Oral Specimens of Marmosets  
Fed Different Dietary Regimens

TYPE OF SAMPLE AND DILUTION	MICROBIAL CATEGORIES ENUMERATED	DIETARY REGIMENS					
		Hard Dry Pellets of Monkey Chow		Soft Moist Marmoset Diet		Soft Moist Carbohydrate Diet	
		$\bar{X}$	S.E.	$\bar{X}$	S.E.	$\bar{X}$	S.E.
Oral Swab  N X 10 <sup>5</sup> /ml  Swab Suspension	Total Anaerobes	139.6*	24.0	99.7*	12.6	339.3	33.2
	Total Aerobes	61.2*	11.1	37.7*	3.7	129.3	19.0
	Neisseria	25.7/	6.6	10.7*	1.4	17.3	2.2
	Streptococci	18.1*	4.0	12.0*	1.7	53.6	6.6
	Bacteroides	14.0/	3.0	4.3*	0.8	30.8	6.0
	Fusobacteria	7.8	1.1	8.7	1.4	10.3	1.3
	Veillonella	0.09*	0.04	0.006*	0.004	2.2	0.7
	Enterics	0.07	0.04	0.01	0.005	0.07	0.02
	Staphylococci	0.01*/	0.006	0.009*	0.003	0.03	0.006
	Candida	0.0002	0.00009	0.006*	0.002	0.00008	0.00005
	Lactobacilli	0	0	0.001	0.0008	0.0007	0.0005
Crevicular Fluid N X 10 <sup>5</sup> /ml Paper Point Suspension	Total Anaerobes	9.1*	1.1	9.7*	1.4	34.8	7.0
	Total Aerobes	2.6*	0.3	2.2*	0.4	12.1	2.9
	Bacteroides	1.2*	0.2	0.8*	0.2	4.0	0.7
	Neisseria	1.0/	0.2	0.4*	0.1	1.3	0.3
	Fusobacteria	0.6*	0.1	0.8*	0.1	1.5	0.3
	Streptococci	0.3*	0.07	0.4*	0.1	3.5	0.7
Residual Saliva N X 10 <sup>3</sup> /ml Loop Suspension	Total Anaerobes	17.3	2.8	12.6*	2.3	30.0	5.7
	Total Aerobes	9.0/	1.9	4.4*	0.7	12.1	3.0
	Neisseria	2.6	0.4	2.3	0.4	4.5	1.0
	Streptococci	1.3	0.3	0.6	0.2	2.1	1.3

<sup>1</sup> Mean counts based on eight replica samples collected semi-weekly from six animals.

\* Indicate significant differences (P < .05 to <.001) to carbohydrate diet.

/ Indicate significant differences (P < .05 to <.001) between hard and soft diets.

Table 2

Analysis of Variance: Summary of Diet Associated Highly Significant  
and Nonsignificant Microbial Counts

Microbial Category	Oral Specimen	Analysis of Variance					
		Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio	P
Anaerobes	Oral Swabs	Diets	$1.58 \times 10^{10}$	2	$7.91 \times 10^{15}$	$0.003 < 1.0 \times 10^{-6}$	
		Error	$4.22 \times 10^{16}$	141	$3.00 \times 10^{14}$		
		Totals	$5.81 \times 10^{16}$	143			
Acrobates	Oral Swabs	Diets	$2.17 \times 10^{15}$	2	$1.08 \times 10^{15}$	$0.001$	$4.8 \times 10^{-6}$
		Error	$1.14 \times 10^{16}$	141	$8.12 \times 10^{13}$		
		Totals	$1.36 \times 10^{16}$	143			
Streptococci	Oral Swabs	Diets	$4.84 \times 10^{14}$	2	$2.42 \times 10^{14}$	$0.002 < 1.0 \times 10^{-6}$	
		Error	$1.43 \times 10^{15}$	141	$1.01 \times 10^{13}$		
		Totals	$1.91 \times 10^{15}$	143			
Fusobacteria	Oral Swabs	Diets	$1.46 \times 10^{12}$	2	$7.29 \times 10^{11}$	$0.94$	$3.9 \times 10^{-1}$
		Error	$1.09 \times 10^{14}$	141	$7.76 \times 10^{11}$		
		Totals	$1.11 \times 10^{14}$	143			
Enterics	Oral Swabs	Diets	$7.08 \times 10^8$	2	$3.54 \times 10^8$	$0.80$	$4.5 \times 10^{-1}$
		Error	$6.25 \times 10^{10}$	141	$4.43 \times 10^8$		
		Totals	$6.32 \times 10^{10}$	143			

Table 3

## Identified Oral Microorganisms Cultured From Marmosets

Family	Genus	Species
Neisseriaceae <sup>1</sup>	Veillonella	alcalescens
		parvula
	Neisseria	flavescens
		flava
		perflava
Micrococcaceae <sup>1, 2</sup>	Staphylococcus	epidermidis
		aureus
	Sarcina	flavas
Lactobacillaceae <sup>1</sup>	Lactobacillus	spp (3)
	Leuconostoc	spp (2)
	Peptostreptococcus	productus
		faetidus
	Streptococcus	mitis
		sanguis
		mutans
		anginosus
		bovis
		salivarius
		sp (1)
Enterobacteriaceae <sup>1</sup>	Escherichia	coli
	Paracolobacterium	coliforme
	Proteus	mirabilis
	Enterobacter	aerogenes
		cloacae
	Klebsiella	pneumoniae
Pseudomonadaceae <sup>2</sup>	Pseudomonas	aeruginosa
Achromobacteraceae <sup>2</sup>	Achromobacter	anitratu (Herellea)
		lwoffi (Mima)
	Alcaligenes	faecalis
	Flavobacterium	aquatile
Bacteroidaceae <sup>3</sup>	Bacteroides	oralis
		fragilis
		corrodens
		melaninogenicus
	Fusobacterium	fusiformis
Corynebacteriaceae <sup>1</sup>	Corynebacterium	sp (1)
Actinomycetaceae <sup>1</sup>	Actinomyces	spp (4)
Mycoplasmataceae <sup>1</sup>	Mycoplasma	spp
Cryptococcaceae <sup>2</sup>	Candida	albicans
Sphaerophoraceae (?) <sup>3</sup>	Leptotrichia	buccalis

1 Classified by Bergey's Manual of Determinative Bacteriology, R. S. Breed, E. Murray, N.R. Smith, et al., Williams and Wilkins Co., Baltimore, Maryland, 1957.

2 Classified by Gradwohl's Clinical Laboratory Methods and Diagnosis, S. Frankel, S. Reitman and A. Sonnenwirth, C.V. Mosby Co., St. Louis, Missouri, 1970.

3 Classified by The Pathogenic Bacteria, L.D.S. Smith and L. Holdeman, Charles Thomas Publisher, Springfield, Illinois, 1968.

Table 4

Groupings of Unidentified Aerobic Gram Negative Rods\*  
Isolated from the Marmoset Oral Cavity

Carbohydrate Activity	Cellular Morphology	Colonial Morphology**	Motility	Catalase	Oxidase	Nitrate
I. Fermentative (Glucose - Acid, other carbohydrates† variable)	Rods	Large, grayish, circular, entire, convex, shiny <sup>1</sup>	-	+	+	+
	Rods	Large, pink, circular, entire, slightly umbonate <sup>2</sup>	-	+	+	-
	Rods	Medium, light pink, circular, entire, convex, shiny <sup>3</sup>	+	+	-	-
	Rods	Large, gray, circular, convex <sup>1</sup>	-	-	+	+
	Rods	Small-medium, circular, translucent, entire, convex, granular <sup>3</sup>	+	+	+	-
II. Nonfermentative to Alkaline	Rods	Small-medium, slightly irregular, convex, translucent, undulant foamy edges <sup>1</sup>	+	+	+	+
	Rods	Small, light pink, entire to slightly undulant, convex, rough <sup>3</sup>	+	-	+	-
	Rods	Small, light pink center and translucent edge, mucoid, circular, pulvinate <sup>3</sup>	-	+	+	-
	Rods	Medium, gray, circular, umbonate, entire <sup>1</sup>	-	+	+	+
	Rods	Small, light pink, entire, circular, pulvinate, smooth <sup>3</sup>	-	-	+	+
	Rods	Medium-large, cream, circular, entire, convex, shiny <sup>3</sup>	-	+	-	+
	Rods	Medium, light purple, green metallic center, circular, entire, convex <sup>2</sup>	-	+	+	-
	Vacuolated Rods	Small, translucent, umbonate, irregular <sup>1</sup>	-	-	+	-
	Rods	Pinpoint, translucent, raised <sup>1</sup>	-	-	-	+

\*Negative TSI, MRVP, Indol, H<sub>2</sub>S, and LAOC. Variable reactions from O-F, Citrate, Urea, Gelatin, and Litmus Milk.

\*\*Large, >2 mm; Medium, >1 mm <2 mm; Small, >0.05 mm <1 mm; Pinpoint, <0.5.

†Other carbohydrates included sucrose, maltose, xylose, starch, and mannitol.

<sup>1</sup>Described on 5% Horse Blood Agar.

<sup>2</sup>Described on EMB Agar.

<sup>3</sup>Described on Desoxycholate Agar.

Characteristic of Frequently Isolated Miscellaneous Unidentified  
Microorganisms from the Marmoset Oral Cavity

Cellular Morphology	Colonial Morphology†	Oxygen Requirement	Catalase	Oxidase*	Nitrate	Glucose	Sucrose*	Fructose*	Maltose*	7.5% NaCl*	Glucose*††	
											Ox	FE
<b>GM<sup>-</sup> COCCI</b>												
Diplo	Large, yellow, circular, convex to raised	ae	-	+	-	+	+	+	+			
Diplo	Large, cream, circular, entire, raised, opaque	ae	-	+	-	+	-	+	-			
Diplo	Medium, yellow, circular, entire, raised	ae	-	+	+	+	+	+	+			
Diplo	Medium, gray, irregular, lobate, highly convex	ae	-	+	+	-	-	-	-			
Diplo	Medium, yellow, circular, undulant, pulvinate	ae	-	+	+	+	-	-	-			
Diplo	Medium, yellow, circular entire, umbonate	ae	+	+	+	+	+	+	+			
Diplo/ Tetrad	Large, gray to white irregular, wrinkled	ae										
	Small, yellow, circular, entire, pulvinate, rough	an	V	V	V	-	-	-	-			
<b>GM<sup>+</sup> COCCI</b>												
Irregular	Medium, white circular, entire on Sabouraud Dextrose Agar	ae	+		-	+				G	+	+
Tetrads	Small, translucent to slightly pigmented, pulvinate, rough on Veillonella Agar	ae	-		+	+				-	+	+
Tetrads	Medium to large, gray with whitish center, circular, entire, convex	ae	-		-	+				-	-	-
<b>GM<sup>+</sup> RODS</b>												
Filament or diphth	Small, white, raised, wrinkled	ae	+		+	+						
Diphth	Small, white, circular, entire, pulvinate, glistening	ae	-		+	+						
Filament or diphth	Medium, white, circular, entire with wrinkled or folded surface	ae	-		+	-						
Diphth	Medium, translucent, slightly, convex, rhizoid, bubbly	ae	-		-	-						
● hth	Medium to large, white, entire, circular	an	-		+	+						

\*Blank spaces indicate reactions considered irrelevant.

†Large, > 2 mm; Medium, > 1 mm < 2 mm; Small, > 0.5 mm < 1 mm; Pinpoint, < 0.5 mm  
on blood agar unless otherwise indicated.

††Glucose - Ox = oxidation, FE = fermentation.



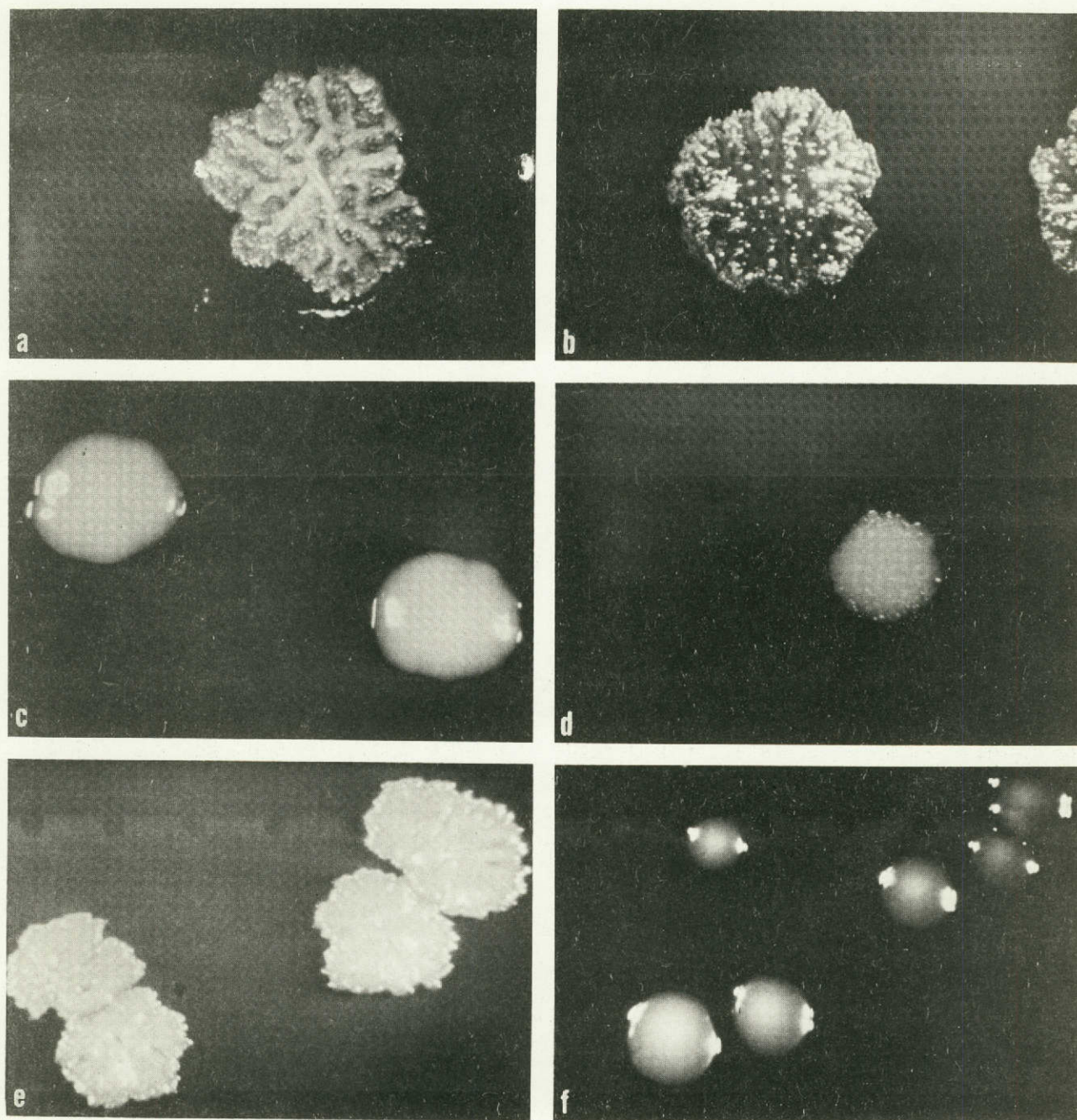


Fig. 1. Variations in colonial morphology of a prevalent gram negative coccoid organism of the oral microflora of marmosets. a and b - frequently observed white colonies on blood agar plates incubated aerobically. c and d - frequently observed yellow colonies on blood agar plates incubated anaerobically. e - white colonies from aerobic subcultures of colonies in a or b. f - yellow colonies from aerobic or anaerobic subcultures of colonies in a, b, c, or d. (Mag. X 7)



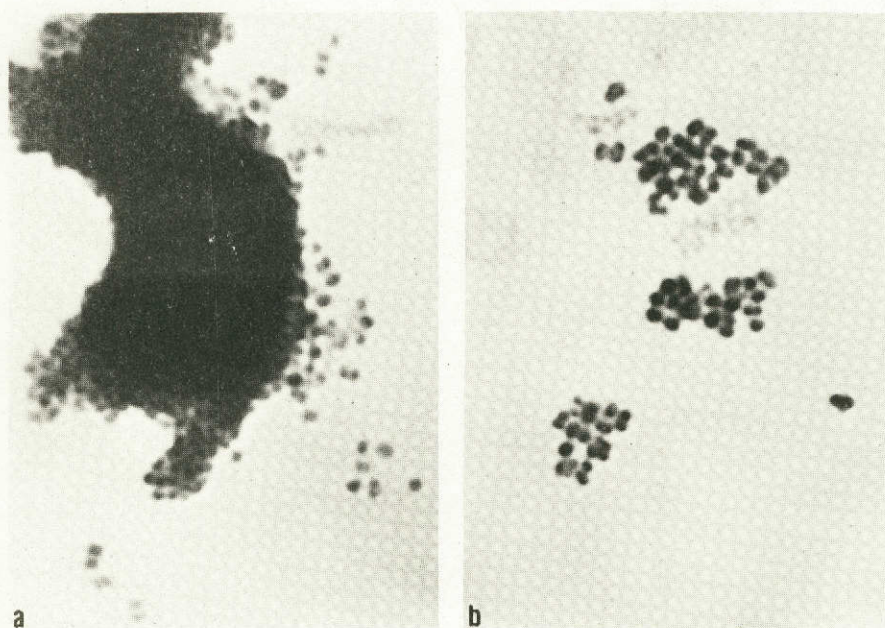


Fig. 2. Variations in cellular morphology of a prevalent gram negative coccal organism of the oral microflora of marmosets. a - gram negative diplococci (Mag. X2,500). b - gram negative tetrads (Mag. X 2,000).

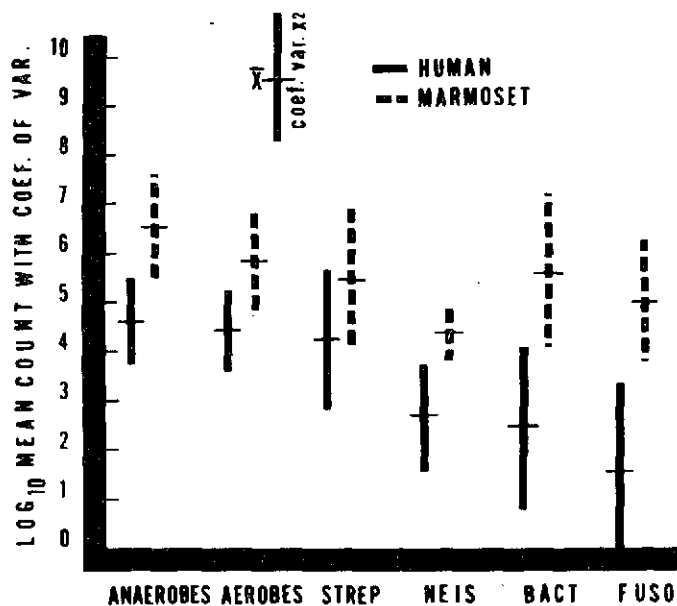


Fig. 3. Comparison of the predominant microflora cultured from the crevicular fluid of a representative human and a marmoset. Means and coefficients of variation (counts/ml of paper point suspension) are based on eight samples from each subject; strep, total streptococci, neis, neisseria, bact, bacteroides, fuso, fusobacteria.

### PART III

#### Effects of Immunosuppression, Antibiotics and Protected Environments on the Human Oral Microflora

The primary goal of defining the oral hygiene requirements for prolonged space missions was to establish practical and adequate means of preventing health hazards which might originate from the human mouth. A concerted effort toward this goal was made with the marmoset model system on the basis that the results would be generally applicable to humans. In view of the difficulty in relating information gained from one animal species to another, confirmatory data must eventually be obtained from humans. Consequently a part of our research effort was directed to oral microbiologic studies in man under conventional and non-conventional environments. The subjects included normal (apparently healthy) subjects and leukemia patients confined to either conventional hospital quarters or to protected environments in the form of sterile life island units or laminar air rooms. It was assumed that the microbiologic data obtained from these patients might reflect oral microbial changes comparable to those that might be encountered under stress of extended space missions.

Antileukemic therapy induces immunosuppression followed by a high frequency of potentially fatal oral bacterial infections which require frequent or prolonged antibiotic medication. Preventive measures against these infections include intensive antibiotic prophylaxis and prolonged isolations of patients in protected environments. Such infectious conditions are

analogous to the reported enhanced susceptibility to infection at high altitudes, the influence of stress on subjects under confined conditions, and the effects of antibiotic prophylaxis and/or antibiotic therapy on the normal microflora and superinfection. The pathology and treatment of acute leukemia thus combine to create unique conditions in which to study the effects of immunosuppression, antibiotics and protected environments on resident and transient human oral microflora. To delineate these effects, the oral microbial population dynamics of acute leukemia patients were monitored in conventional and protected environments before, during, and after treatment with immunosuppressive drugs, antibiotic prophylaxis and/or antibiotic therapy. Data from these patients were compared to those from normal (non-cancer) individuals.

#### Materials and Methods

The study group consisted of 12 adolescent or adult patients with acute leukemia hospitalized in the Developmental Therapeutics Department of The University of Texas M. D. Anderson Hospital and Tumor Institute. Each had a natural dentition and moderate to good oral health on admission. After establishing the diagnosis, six of the patients were treated in life island units or laminar air flow rooms and six in conventional hospital rooms. Six healthy members of the staff of The University of Texas Dental Science Institute served as nonleukemic controls.

The life island unit consists of a bed enclosed in a plastic tent.<sup>1</sup> Air circulating in the unit is pumped through high efficiency filters capable of

eliminating more than 99.9% of the particles greater than 0.3 microns in diameter. When the tent is maximally inflated there is sufficient space for the patient to stand or sit beside the bed. Procedures are performed through plastic sleeves built into the sides of the tent. All items of patient care are presterilized and passed through locks equipped with ultraviolet lights and returned by the same route following use.

One wall of the laminar air flow rooms consists of a bank of high efficiency particulate air filters.<sup>2</sup> The filtered air circulates through the room in a horizontal direction at a velocity of 90 ft/min. Locks similar to those in the life island units are used for the in and out passage of patient care items. Personnel entering the unit for examination and sampling procedures must be attired in sterile caps, masks, gloves, gowns, and boots.

Each of the patients treated in the protected environments underwent a four-day preparation period. Intensive antibiotic prophylactic regimens were given and cleaning procedures were used to eliminate endogenous microbial contamination. The antibiotics listed in Table 1 were administered as non-absorbable oral suspensions swirled in the mouth for 30 seconds before swallowing and as ointments applied to the ears, nose, gingiva, groin, and perineum four times daily. Axillary, pubic and head hair were cut and fingernails and toenails were trimmed and cleaned with an orange wood stick and brush. Phisohex baths, shampoos and showers followed by washing with isoprophyl alcohol were used to clean the skin.

Patients in the protected environments were provided with sterile bed clothes, bedding, food and water throughout the period of isolation. Routine oral hygiene was practiced after each meal including mouth rinses and tooth brushing. The buttocks and perianal regions were washed with Phisohex after each bowel movement.

The conventionally hospitalized leukemic patients were treated with organism specific antibiotics only when indicated. Broad spectrum antibiotics were administered intravenously whenever the temperature reached 101° F. or above. Pyopen (carbenicillin), Garamycin (gentamicin sulfate), and Keflin (sodium cephalothin) were given until the causative agent was identified.

The various chemotherapeutic agents used in the leukemia patients are shown in Table 2. The drugs were usually administered in combinations in five day courses repeated at approximately two week intervals. Timing and duration of therapy was governed by the bone marrow response and changed as needed.

The oral bacterial sampling schedules were subject centered to permit individual evaluation. Oral specimens consisting of stimulated saliva and sublingual residual saliva were obtained as soon as a diagnosis was made and at least twice weekly thereafter until a treatment protocol was adopted. Subsequent sampling varied with the type and duration of treatment. Each patient was sampled at least once weekly throughout the hospital course.

The specimens of saliva were collected at approximately 7:00 a.m. before eating, toothbrushing, mouth rinsing, and oral medication. Stimulated saliva was obtained by chewing sterile rubber bands, and residual saliva by calibrated wire loops. Use of the loops permitted sampling even when the patient was comatose or incapable of providing stimulated saliva. Following the removal of aliquots for microscopic examination, each specimen was processed and plated on a variety of differential and selective media for isolation and enumeration of the microbial categories as previously described.<sup>3</sup> Species and strain differentiations were made only for those isolates considered unique or reflective of a significant change in the prevailing oral microflora. The microbial spectrum and counts in specimens obtained during therapy were compared with those taken before and after treatment and with those collected from the healthy nonleukemic control subjects.

The skin, nose, ears, throat, urine, and stools were cultured before entry into the protected environment units and at weekly intervals thereafter. Blood, throat, urine, and local lesions were cultured in both the conventionally hospitalized and protected environment patients whenever there was clinical evidence of possible infection.

## Results

### Clinical Observations

Approximately 20% of untreated leukemic patients develop oral ulcerations involving the lips, gingiva, tongue, palate and/or buccal mucosa



which appear as punched out or superficial purulent mucosal erosions. Cultures from these sites usually yield gram positive cocci indigenous to the oral cavity and the circumlabial skin. The frequency of oral infections rose appreciably in the patients given antileukemic drugs productive of a prolonged and profound bone marrow depression. The vast majority of oral infections in these patients was precipitated by gram negative bacilli and by fungi.

The most common causative organisms were species of Pseudomonas, Klebsiella, Serratia, Proteus, Escherichia, Enterobacter, and Candida. The gram negative species are seldom found in the mouths of healthy individuals but are often isolated from patients receiving antibiotics. In the leukemic patients with inadequate and incompetent granulocytic reserves the organisms were able to invade sites of local trauma or drug induced desquamation and initiate a cellulitis. No part of the oral mucosa was immune to invasion. Lesions produced by pseudomonas were blue-black and necrotic with erythematous halos; by serratia, discolored and escharotic; by klebsiella, proteus, escherichia and enterobacter, gray-white and exudative; by candida, creamy-white, raised and patchy. Combinations of the gram negative bacilli and candida, with or without gram positive cocci, produced extensive mucosal ulceration and destruction. Even the most insignificant appearing oral lesions were capable of provoking a septicemia in the myelosuppressed leukemic patients unless rapidly and specifically diagnosed and effectively managed.

### Bacteriologic Findings

Direct microscopic examination of the saliva samples obtained from the leukemic patients during chemotherapy disclosed the presence of massive numbers of desquamated epithelial cells. Many of the smears contained numerous blastospores and pseudohyphae of candida. Oral spirochetes were rarely observed during antileukemia treatment and were never seen following antibiotic treatment. Protozoa (amoeba or trichomonas) were not detected in any of the subjects studied.

There were no profound differences in either the distribution or the median counts of the oral microflora between the nonleukemic subjects and the patients with acute leukemia prior to treatment (Table 3). Most count variations were well within the range of subject and/or procedural variability. All data were expressed as medians to negate the influence of extremely high or low individual values on the small group size.

Distinctive count differences were noted in the leukemic patients before and after treatment with immunosuppressive drugs. The nature and relative magnitude of these differences are compared in Fig. 1. All of the microbial counts increased appreciably during therapy except for Streptococcus salivarius which showed a notable decline with specific drug medications. There were particularly prominent increments in the mycoplasma and enteric groups. The intraoral increases in the latter group comprised of serratia, enterobacter, klebsiella, escherichia, proteus, and pseudomonas bacteria were often accompanied by the

previously described clinical lesions.

The effects of antibiotic treatment on the oral microflora of the 12 immunosuppressed leukemic patients are summarized in Table 4. Topical applications of the antibiotic prophylactic regimens greatly reduced all of the microorganisms monitored except for candida. Although the systemically administered antibiotics (gentamicin, cephalothin and/or carbenicillin) produced marked reduction in Streptococcus salivarius, fusobacteria and staphylococci, the numbers of most other specific microorganisms increased during this period.

The oral microbial assessments of a representative nonleukemic subject are detailed in Fig. 2. This pattern typified the nonleukemic group except for the relatively high levels of candida and staphylococci. The enterics recovered from the salivary samples of this individual were always confined to Alcaligenes spp. Patterns of representative leukemia patients in each of the treatment groups are presented in Fig. 3 through Fig. 6.

The influence of antibiotic prophylaxis, protected environment and immunosuppressive drug therapy in a patient with acute myelogenous leukemia is depicted in Fig. 3. The intensive antibiotic protocol and protected environment resulted in increased counts of candida and mycoplasma and pronounced decreases in all of the other monitored organisms. The most prominent declines were registered by Streptococcus salivarius, veillonella, fusobacteria and staphylococci. Although the oral flora was

generally suppressed, many types of microorganisms persisted in the mouth at relatively high levels. In contrast, only candida and klebsiella were recovered from the throat and only Escherichia coli was found in the stools of this patient during treatment. Immunosuppression was evidenced by the level and rate of the elevation of oral microorganisms at the termination of antibiotics prior to patient removal from the protected environment. The counts diminished to the pretreatment levels after completion of chemotherapy and cessation of antibiotics.

Changes in the oral microbial counts in relation to clinical infection and specific antibiotic treatment in immunosuppressed conventionally hospitalized patients are contained in Fig. 4 through Fig. 6. In each instance, these oral microorganisms which showed pronounced increases in counts were plotted against body temperature, antibiotic therapy and disease entity. Counts of the other organisms which were monitored concurrently are represented by the shadowed areas.

Fig. 4 shows the effect of systemic antibiotics on the oral microflora in an immunosuppressed leukemic patient with a Klebsiella pneumoniae superinfection of the oral mucosa. Except for lactobacilli the entire oral microflora was replaced by aerobacter-klebsiella organisms for more than three days. The infection was accompanied by a fever of 101°F. to 103°F. and was treated with carbenicillin, cephalothin, and kanamycin given intravenously and gentamicin applied topically to the oral ulcerations. Recovery from the infection was followed by a qualitative and quantitative

restoration of the antecedent oral microflora.

The changes in oral microflora in a myelosuppressed patient with acute myelogenous leukemia given antibiotics for a fatal E. coli septicemia are graphed in Fig. 5. E. coli was recovered from the saliva of this patient in varying numbers for several weeks before the death of the patient.

The oral microbial profile in a patient with myelogenous leukemia who developed fatal Candida albicans septicemia while on antileukemic drugs is shown in Fig. 6. This patient had been given broad spectrum antibiotics for a fever of unknown origin. There was a striking intraoral increase in Candida albicans for more than a week before the organism was ultimately isolated from the blood.

The immunologic profile of a nonleukemic control subject is compared to that of a leukemic patient receiving cancer chemotherapy prior to an overwhelming clinical infection in Fig. 7. The total anaerobic counts are included as representative counts for all the microbial categories monitored. Serum levels were less variable than salivary levels and were quite comparable in both individuals except for the higher levels of Serum IgD of the leukemia patient. The most significant aspect of the data were the decreasing values of secretory IgA and salivary lysozyme concurrent with bacterial increases during immunosuppressive therapy. Also, the lowest level of bacterial count corresponded to the highest levels of secretory IgA and salivary lysozyme. However, since the patient was

placed on antibiotics at this time, two variables were superimposed and the single or combined effects of each cannot be delineated.

### Discussion

The clinical and bacteriological findings of this study provided some insight into the interactions of oral microbial ecology and host-parasite relationships. The interactions involved oral microbial population shifts, host injury and the alteration and/or impairment of intrinsic and extrinsic components of the host defense complex.

The high incidence of oral gram negative bacillary and candida infections in patients undergoing treatment for acute leukemia was attributable to host defense aberrations and to the inability of the available antibiotics to effectively eradicate the organisms. Hersh and Freireich<sup>4</sup> have postulated that bacterial infections in patients given immunosuppressive drugs are primarily related to leucopenia and to poor antibody responses and fungal infections to an interference with chronic mononuclear cell infiltration and/or to impaired delayed hypersensitivity. The deficiency of normal leucocytes (granulocytes and lymphocytes) results from leukemic infiltration of the marrow during active periods of the disease.<sup>5</sup> Although the leukemic process does not alter the phagocytic activity of mature neutrophils, the disease prompts the formation of large numbers of blast cells and immature granulocytes with little or no phagocytic or digestive action. Since most antibiotics are bacteriostatic in vivo, only removal and destruction of the offending organisms by quantitatively ample and

qualitatively competent phagocytes would have completely eliminated their pathogenic potential.

Other intrinsic defense imperfections were indicated by direct microscopic examination of the saliva which revealed a drug associated exfoliation of the oral epithelium manifested clinically by a thinning of the oral mucosa. That the disruption of the mucosal integrity may have affected the immunologic competence of the oral mucosa was evidenced by the high prevalence of oral ulcerations and infections encountered during successive courses of antileukemia therapy.

The noteworthy increments in numerous oral microbial populations which occurred in the leukemic patients during chemotherapy, the intraoral establishment of exogenous bacteria and their replacement of some of the endogenous flora, and the initiation of pathoses by normally saprophytic microbes are all indications that the antileukemic agents may have suppressed cellular and humoral immune mechanisms in these patients. The antileukemic drugs are known to affect both the specific and nonspecific host defense systems. Most interfere with DNA and RNA synthesis to prevent cell multiplication. Purine antagonists such as 6-mercaptopurine depress both the antibody and established immune responses and selectively inhibit IgG production; alkylating agents such as cyclophosphamide deter the antibody response by lysis of lymphoid cells and interference with ongoing DNA synthesis; periwinkle alkaloids such as vincristine, produce metaphase arrest and suppress established hypersensitivity reactions; folic acid

antagonists such as methotrexate, block the primary antibody response and prevent the production of sufficient numbers of specifically sensitized small lymphocytes and the RNA and protein synthesis required for the expression of delayed hypersensitivity; steroids such as prednisone, modify the inflammatory reaction by inhibiting leucocyte emigration and by depressing antibody formation.<sup>4</sup>

The significance of extrinsic protective factors in reinforcing the intrinsic defense systems against infection was demonstrated by the effectiveness of topically administered antibiotics in eliminating microorganisms from the skin and most of the body orifices. Despite these prophylactic procedures, however, many organisms were still recovered in substantial numbers from the oral cavity. These findings suggest that the antibiotic spectra, dosages or modes of administration lacked the capacity to control the persisting organisms. The oral cavity may thus serve as a reservoir of organisms which can proliferate and cause local or disseminated potentially fatal infectious complications in immunosuppressed individuals. Pronounced increases or retention of such organisms in the oral cavity may serve as both diagnostic and predictive markers for patient care and specific antimicrobial treatment.

The effects of systemically administered antibiotics on the oral microflora in the conventionally hospitalized patients were similar but less pronounced than those of the prophylactic topical antibiotics given the patients in the protected environments. The systemic antibiotics were given either



for specific infections or fevers of unknown origin. Because of the difference in route of administration they had but a limited effectiveness against the oral microflora. This difference conceivably contributed to the greater prevalence of oral super-infections in the conventionally hospitalized group.

Patients with acute leukemia have essentially normal antibody responses, delayed hypersensitivity reactions and serum immunoglobulin levels prior to treatment. Using quantitative immunodiffusion methods, McKelvey and Fahey<sup>6</sup> and McKelvey and Carbone<sup>7</sup> found no significant deviations in IgG, IgA and IgM levels in acute myelogenous leukemia and only a slightly diminished IgA level in acute lymphocytic leukemia. Although distinctive alterations in specific members of the oral microflora were noted in the patients given the antileukemia drugs, the specific immune factors which may have been altered were not delineated in the present study. The action of immunosuppressive drugs on those immune factors which contribute to local resistance in the oral cavity is currently being investigated. In addition there was preliminary evidence that some of the antimetabolites included in the treatment protocols selectively suppressed the growth or altered the metabolism of some of the oral microorganisms, notably polysaccharide producing streptococci. This aspect is also under further investigation.

### Conclusions

Host defense imperfections in acute leukemia patients undergoing immunosuppressive therapy were revealed by: 1) a high incidence of oral

gram negative bacillary and candida infections; 2) the pronounced desquamation of the oral epithelium and the clinical thinning and ulceration of the oral mucosa; 3) the distinctive population shifts of many orally prominent microorganisms concurrent with an intraoral preponderance of exogenous gram negative bacilli; and 4) the oral proliferation of indigenous and transient microorganisms resulting in local or disseminated potentially fatal complications.

The antibiotic procedures used were effective in eliminating microorganisms from most body orifices but never from the oral cavity. The oral cavity may thus serve as a potentially infectious microbial reservoir in immunosuppressed individuals.

There was preliminary evidence of selective growth suppression and/or metabolic alteration of specific streptococcal species by certain antimetabolites in the treatment protocols.

#### Acknowledgements

The investigators wish to acknowledge Dr. Samuel Dreizen of The University of Texas Dental Science Institute and Dr. Gerald P. Bodey of The University of Texas M. D. Anderson Hospital and Tumor Institute for their guidance and participation which made this study possible.

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TABLE 1

## ANTIBIOTIC REGIMENS

ORAL REGIMENS	
Antibiotics	Dosage
<u>Antibacterial Agents</u>	
<u>Regimen A</u>	
Paromomycin sulfate	500 mg
Polymyxin B Sulfate	70 mg
Vancomycin hydrochloride	250 mg
<u>Regimen B</u>	
Gentamicin sulfate	200 mg
Vancomycin hydrochloride	250 mg
<u>Antifungal Agents</u>	
Amphotericin B	500 mg
Nystatin	3.6 million units

All antibiotics except Nystatin were given in flavored solution every 4 hours.  
Nystatin was given as 6 tablets and 6 cc suspension every 4 hours.

## TOPICAL REGIMENS

Antibiotics	Spray (cc)	Concentration in ointment (g)	Gel (g)
Neomycin sulfate	100 mg	50 mg	100 mg
Nystatin	--	25,000 units	50,000 units
Vancomycin hydrochloride	10 mg	5 mg	10 mg
Polymyxin B sulfate	5 mg	2.5 mg	5 mg

\*Supplied by Schering Corporation as Garamycin syrup.

\*\*Supplied by E. R. Squibb and Sons as Preparation AJS.

TABLE 2  
LIST OF ANTILEUKEMIC AGENTS USED AT MDAH

AGENT	SYMBOL	ACTION	COMBINATIONS FREQUENTLY PRESCRIBED
Methotrexate <sup>MTX</sup>	M	Folic Acid Antagonist	POMP*
6 Mercaptopurine	P	Purine Analogue	COAP
6 Thioguanine	T	Purine Analogue	DOAP
Cytosan (Cyclophosphamide)	C	Alkylating Agent	OAP
Cytosine Arabinoside (ARAC)	A	Pyrimidine Analogue	ATA
Prednisone	P	Steroid	
Oncovin (Vincristine)	O	Alkaloid	
Daunomycin	D	Antibiotic	
L-Asparaginase		Enzyme	
Hydroxyurea (Hydrea)		DNA Inhibitor	
B <sub>6</sub> GTDR		Purine Antagonist	

\*The second P in the combination is always Prednisone.

ORAL MICROBIAL COUNTS FROM NONLEUKEMIC SUBJECTS AND  
LEUKEMIC PATIENTS BEFORE AND AFTER IMMUNOSUPPRESSIVE THERAPY

MICROBIAL CATEGORY	NONLEUKEMIC (n X 10 <sup>6</sup> /ml)*	LEUKEMIC	
		Before Immunosuppression (n X 10 <sup>6</sup> /ml)*	After Immunosuppression (n X 10 <sup>6</sup> /ml)*
Total Anaerobes	408	354	1140
Total Aerobes	423	228	320
Total Streptococci	306	120	250
Streptococcus salivarius	24	25	0.5
Bacteroides	23	9	75
Neisseria	7	22	64
Veillonella	4	1	8
Fusobacteria	3	0.3	0.1
Lactobacilli	0.00005	0.015	0.102
Staphylococci	0.0035	0.002	0.007
Mycoplasma	0.0016	0	0.0005
Enterics	0.000002	0	0.0014
Candida	0.000005	0	0

\*Median counts from the stimulated saliva of six individuals.

TABLE 4

ORAL MICROBIAL COUNTS FROM IMMUNOSUPPRESSED LEUKEMIC  
PATIENTS BEFORE AND AFTER ANTIBIOTIC TREATMENT

MICROBIAL CATEGORY	Systemically Administered Single and Mixed Antibiotics		Topically Applied Antibiotic Prophylactic Regimens*	
	BEFORE (n X 10 <sup>6</sup> /ml)**	AFTER (n X 10 <sup>6</sup> /ml)**	BEFORE (n X 10 <sup>6</sup> /ml)**	AFTER (n X 10 <sup>6</sup> /ml)**
Total Anaerobes	395	296	575	6.8
Total Aerobes	173	144	245	0.25
Total Streptococci	120	27	177	0.12
Streptococcus salivarius	25	0	14	0
Neisseria	8.0	2.8	12	0
Bacteroides	1.7	4.2	28	0.27
Veillonella	0.8	0.6	13	0.002
Fusobacteria	0.2	0	0.06	0
Lactobacilli	0.01	0.03	0.002	0.0001
Staphylococci	0.006	0.0008	0.001	0
Mycoplasma	0.001	0.02	0.001	0
Enterics	0	0.08	0.01	0
Candida	0	0.002	0.01	0.09

\*Therapy given in protective environment unit.

\*\*Median counts from the stimulated saliva of six patients.

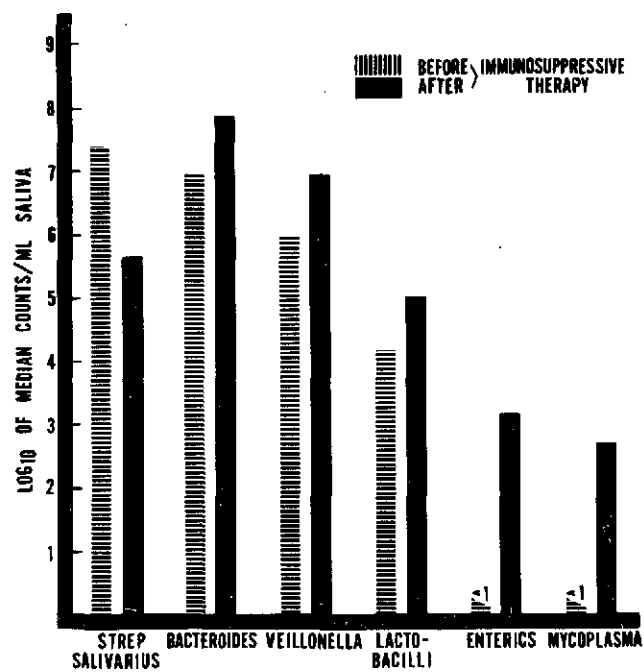


Fig. 1. Distribution of distinctive changes in medial oral microbial counts of six acute leukemia patients before and after chemotherapy.



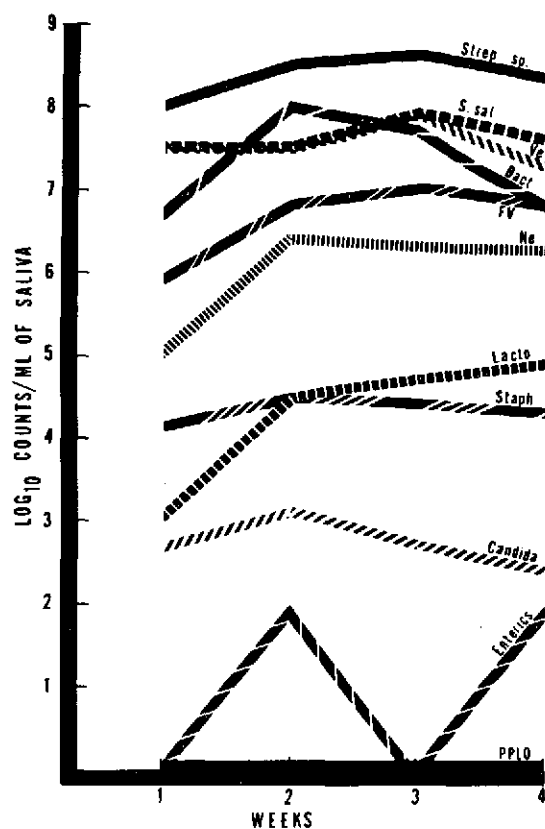


Fig. 2. Oral microbial profile of a representative nonleukemic control subject. Abbreviations: Strep sp., streptococci other than S. salivarius; S. sal., Streptococcus salivarius; Ve., veillonella; Bact., bacteroides; FV., fusobacteria; Ne., neisseria; Lacto., lactobacilli; Staph., salt tolerant staphylococci; PLO., mycoplasma species.

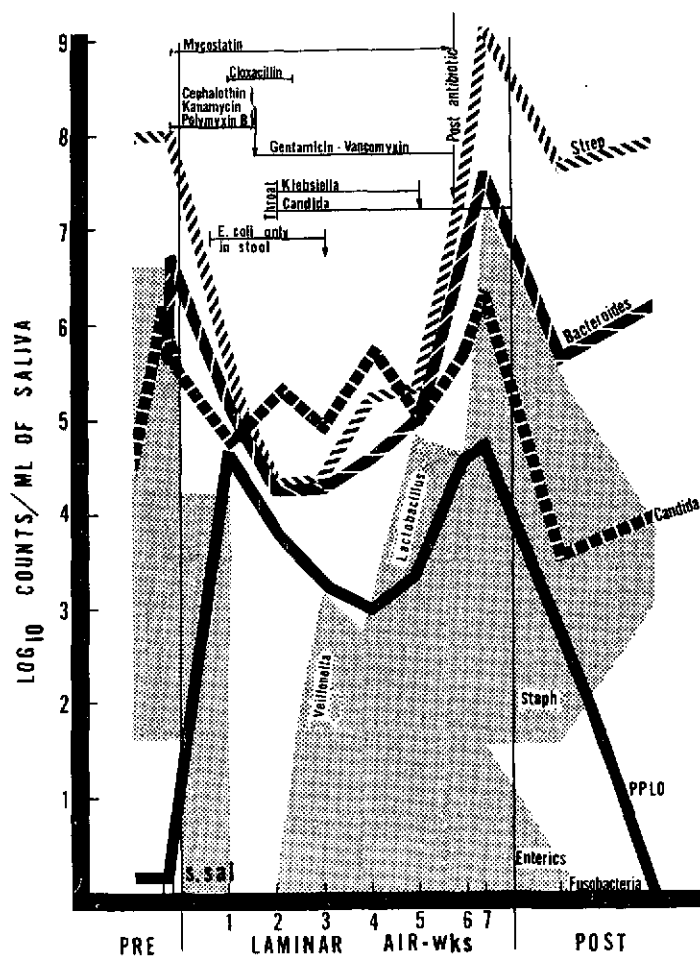


Fig. 3. Oral microbial levels in a patient with acute myelogenous leukemia before, during, and after treatment in a protected environment. Abbreviations: *S. sal*, *Streptococcus salivarius*; *Strep*, streptococcal species other than *S. salivarius*; *PPLO*, mycoplasma species.

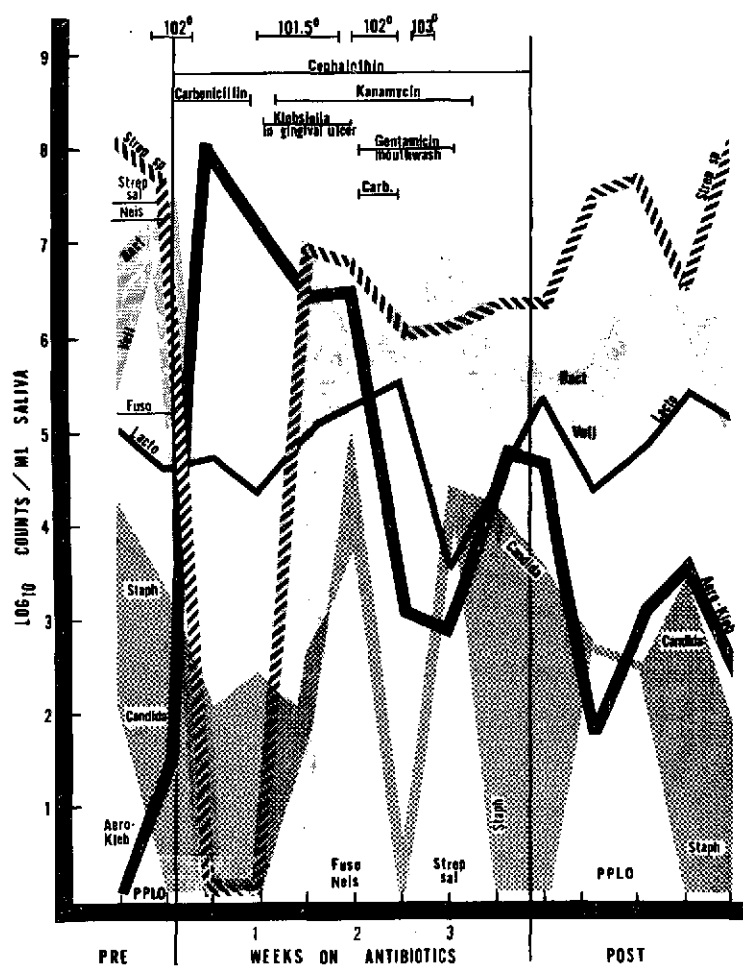


Fig. 4. Oral microbial pattern in a conventionally hospitalized patient with acute myelogenous leukemia given antibiotics for infectious complications during cancer chemotherapy. Abbreviations: Strep sal, *Streptococcus salivarius*; Strep sp, streptococci other than *S. salivarius*; Neis *neisseria*; Bact, *bacteroides*; Veil, *veillonella*; Fuso, *fusobacteria*; Lacto, *lactobacilli*; Staph, salt tolerant staphylococci; Aero-Kleb, *aerobacter-klebsiella*; PPLO, *mycoplasma* species.

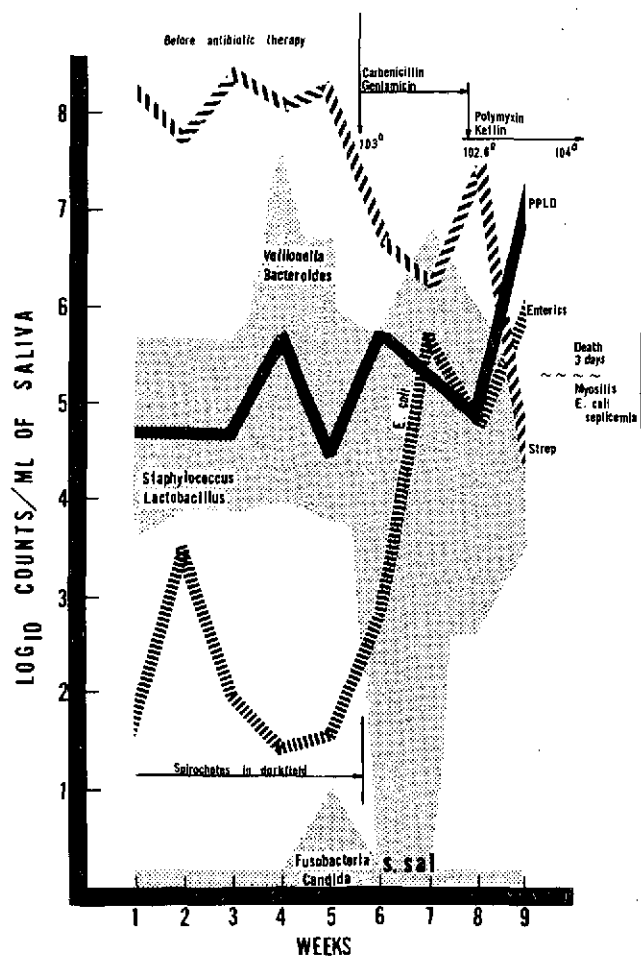


Fig. 5. Oral microbial concentrations in a conventionally hospitalized patient with acute myelogenous leukemia who expired from an *E. coli* septicemia during cancer chemotherapy. Abbreviations: Strep, streptococci other than *S. salivarius*; PPLO, mycoplasma species; S. sal, *Streptococcus salivarius*.

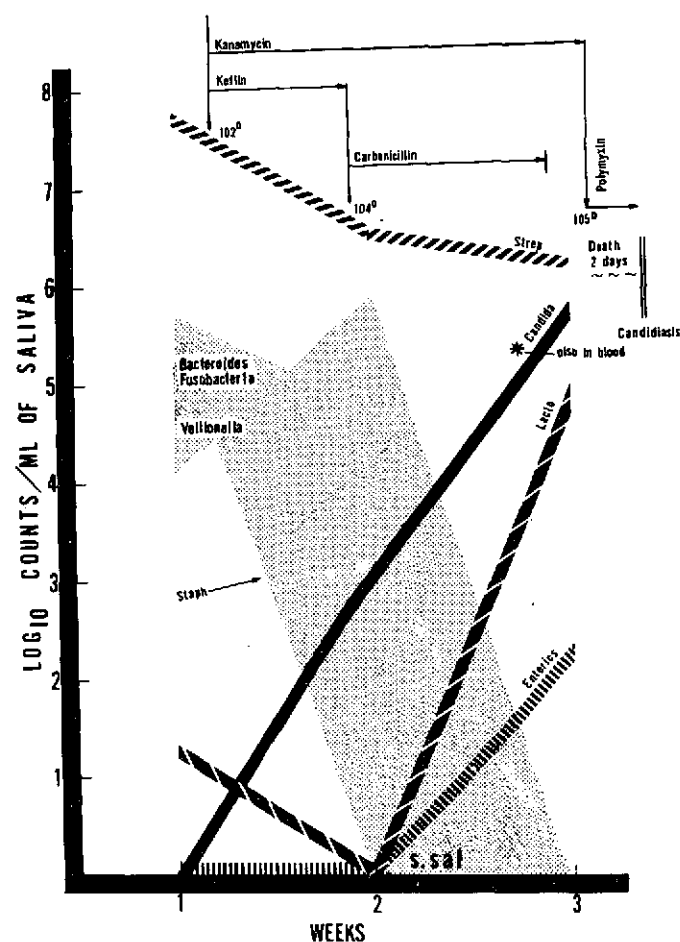


Fig. 6. Oral microbial profile in a conventionally hospitalized patient with acute myelogenous leukemia who died from a candida septicemia during cancer chemotherapy. Abbreviations: Strep, streptococci other than salivarius; S. sal, Streptococcus salivarius; Lacto, lactobacilli; Staph, salt tolerant staphylococci.

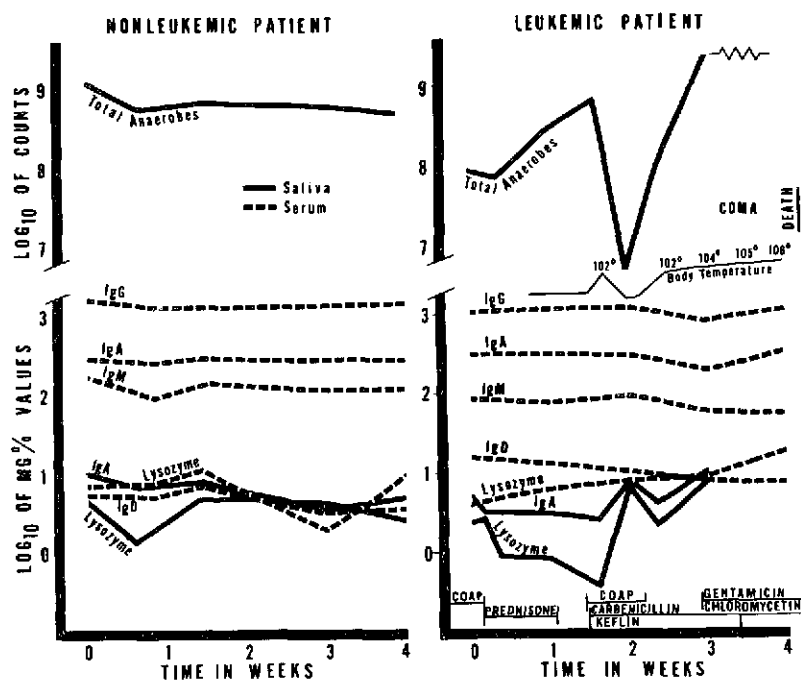


Fig. 7. Comparison of immunologic profile of a control subject and a patient receiving antileukemic therapy. COAP-combined therapy of Cytosine Arabinoside, Oncovin, Cytosine Arabinoside and Prednisone.

## PART IV

### Effectiveness of Chemically Impregnated Paper Wipes In Decontaminating Dental Instruments

Sterile instruments in dental and medical emergency kits may have to be reused during extended space missions (i. e., Sky Lab). This necessitates provision for an inflight method of instrument decontamination. Paper wipes impregnated with chemical disinfectants have been developed for this purpose.

The objective of this investigation was to compare the effectiveness of paper towels saturated in either Zephiran Chloride or Betadine in cleaning dental instruments of bacterial contaminants.

#### Materials and Methods

The paper wipes used in this study for instrument decontamination were cut from paper towels\* to simulate those fabricated for NASA.\*\* After autoclave sterilization the paper wipes were saturated with either sterile deionized water, aqueous 1:750 Zephiran Chloride<sup>a/</sup> or 10 per cent Betadine<sup>b/</sup> immediately prior to testing.

Two types of dental instruments, extraction forceps<sup>c/</sup> and apical elevators<sup>d/</sup>

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\*Crown Sorbette Twin-C Blender Paper Towels available from Crown Zellerbach Corp., New York, New York, were 13.8 cm squares folded to make a 3.5 cm<sup>2</sup> wipe.

\*\*Zephiran Wipes-A, P/N 24-0123, Lot No. 10010.

<sup>a/</sup>Zephiran Chloride available from Winthrop Laboratories, New York, New York.

<sup>b/</sup>Betadine available from The Purdue Frederick Co., Yonkers, New York.

<sup>c/</sup>Forceps, Tooth Extracting No. 210, available from S. S. White Company, Philadelphia, Pennsylvania.

<sup>d/</sup>Elevator Supreme No. 301, available from Supreme Manufacturing Co., Philadelphia, Pennsylvania.

were used to represent dental instruments in general. The instruments were labelled, washed and autoclaved before each experiment.

Each instrument was exposed to five sources of bacterial contamination: 24 hour broth cultures (Trypticase Soy Broth<sup>†</sup>) of Staphylococcus aureus, Escherichia coli, and Candida albicans; suspensions of human dental plaque (5 mg plaque/5 ml of Trypticase Soy Broth); and human stimulated saliva.

The ends of the instruments were submerged (approximately one inch) for 30 seconds in 5 ml volumes of the contaminants, removed and either wiped aseptically or left unwiped and immediately re-submerged for 30 seconds in 5 ml of sterile Trypticase Soy Broth.\* The latter was then serially diluted (10-fold) in 0.1% peptone in normal saline for the plating of residual, viable contaminants. The unwiped instruments were used to assess the degree of contamination of each instrument by the different sources of contamination.

Plates of Staphylococcus 110 Agar\*\*, Desoxycholate Agar\*\*, and Sabouraud Dextrose Agar\*\* were used to enumerate Staphylococcus aureus, E. coli, and Candida albicans respectively. Plates of Heart Infusion Agar\*\*

<sup>†</sup>Trypticase Soy Broth available from BBL Division of BioQuest, Cockeysville, Maryland.

\*Trypticase Soy Broth (BBL) contained 0.5% Tween 80 for the submersion of instruments wiped with Zephiran Chloride and 0.05% sodium thioglycollate for instruments wiped with Betadine for the neutralization of residual disinfectants.

\*\*Obtainable from Difco Laboratories, Detroit, Michigan.



supplemented with 5% defibrinated horse blood was used to assess organisms recovered from the plaque and saliva contaminated instruments. All counts were made from duplicate plates incubated aerobically at 37° for 24 - 48 hours.

### Results

The dental extraction forceps consistently demonstrated a greater degree of contamination than the apical elevators irrespective of the contaminating source (Table 1).

The recovery of contaminants from instruments wiped with either deionized water, Zephiran Chloride or Betadine was significantly less ( $P < 0.1$ ) than that from unwiped instruments (Table 1). Except for instruments contaminated with Candida albicans, the Zephiran Chloride and Betadine wiped instruments had significantly less remaining contamination immediately after treatment than instruments wiped with deionized water (Table 2). Instruments contaminated with Candida albicans, wiped with either Zephiran Chloride or Betadine, and sampled five minutes after treatment were completely free of contamination. There were no significant differences in the recovery of contaminants between the Zephiran Chloride and Betadine wiped instruments (Table 2).

### Discussion

Differences in the amount of contamination on the two types of dental instruments used in this study can be attributed to differences in surface area. The extraction forceps were larger than the apical elevators and

always had the higher amount of contamination.

The fact that instruments wiped with deionized water had significantly less remaining contamination than the unwiped instruments indicates a relatively effective mechanical removal of bacteria by the wiping technic. This effect can be significantly supplemented by the chemical action of disinfectant impregnated wipes. This was evidenced by the significantly greater reduction of contamination by the Zephiran Chloride and Betadine saturated wipes than by the deionized water wipes, and by the complete elimination of Candida albicans from the chemically wiped instruments five minutes after treatment.

#### Conclusions

Two types of dental instruments contaminated with human dental plaque, stimulated saliva and pure cultures of microorganisms were used to determine the effectiveness of chemically impregnated paper wipes in preventing contamination.

Instruments with the largest surface area had the greatest amount of contamination. The mechanical action of deionized water wipes significantly reduced the number of all contaminants and this effect was significantly enhanced by the chemical action of Zephiran Chloride or Betadine saturated wipes. No significant differences were found between the decontamination effectiveness of the Zephiran Chloride and Betadine saturated wipes.

### Acknowledgements

The investigators wish to acknowledge the technical assistance of Mr. Stanley Pease, Laboratory Technician I, in carrying out this study.

Table 1

Recovery of Microorganisms from Specifically Contaminated Dental Instruments  
Before and After Decontamination with Treated Paper Wipes\*

Source of Contamination	Type of Dental Instrument N=6 each	Means $\pm$ Standard Deviations of Counts ( $n \times 10^4$ )							
		Before Wipe		Immediately After Wipe**					
				Sterile Water		Zephiran Chloride		Betadine	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Human Saliva	Forceps #210	238	93	2.6	1.5	0.03	0.08	0.13	0.11
	Elevators #301	36	34	0.075	0.038	0.001	0.002	0.008	0.01
Human Dental Plaque	Forceps #210	21	4.8	0.12	0.04	0.009	0.007	0.002	0.0003
	Elevators #301	2.3	1.0	0.01	0.008	0.0003	0.00005	0.00008	0.0002
Broth culture of <u>Staphylococcus aureus</u>	Forceps #210	306	85	10.4	2.8	2.8	2.0	5.1	3.8
	Elevators #301	47	15	2.3	1.2	0.06	0.03	0.07	0.05
Broth culture of <u>Escherichia coli</u>	Forceps #210	906	261	25	12	0.45	0.88	1.6	1.8
	Elevators #301	197	48	1.1	1.2	0.01	0.02	0.02	0.03
Broth culture of <u>Candida albicans</u>	Forceps #210	18	8	0.1	0.1	0.09	0.08	0.03	0.03
	Elevators #301	1.2	0.3	0.03	0.03	0	0	0.004	0.003

\*Treated paper wipes -- made from 13.8 cm<sup>2</sup> of Crown Sorbette Twin-C Blended paper towels folded to make a 3.5 cm<sup>2</sup> wipe. These were treated by saturation with: 1) sterile deionized water; 2) aqueous Zephiran Chloride 1:750; and 3) 10% Betadine with 1% free I<sub>2</sub>.

\*\*Counts immediately after wipes were all significantly less ( $P < .01$ , paired t-test) than counts before wipes.

Table 2

Statistical Comparison of Mean Differences ( $\bar{d}$ ) Among  
Decontamination Procedures for Dental Instruments\*

Source of Contamination	Paired t-tests Between Treatment **								
	Water vs ZCl Wipes			Water vs Betadine Wipes			ZCl vs Betadine Wipes		
	$\bar{d}$	t	P	$\bar{d}$	t	P	$\bar{d}$	t	P
Human Saliva	1.342	3.801	<.02	1.291	2.783	<.02	0.0514	1.749	<.1
Human Dental Plaque	0.003	3.595	<.01	0.0625	3.662	<.01	0.0035	1.750	<.1
Broth culture of <u>Staphylococcus aureus</u>	4.911	4.873	<.001	3.732	2.831	<.02	1.179	1.137	<.3
Broth culture of <u>Escherichia coli</u>	12.789	3.022	<.02	12.219	3.127	<.01	0.569	1.183	<.3
Broth culture of <u>Candida albicans</u>	0.020	0.495	<.7	0.050	2.058	<.1	0.030	0.927	<.4

\*N=12

\*\*Paper wipes treated by saturation with: 1) sterile deionized water;  
2) aqueous Zephiran Chloride 1:750; and 3) 10% Betadine with 1%  
free I<sub>2</sub>.

## PART V

### Literature Review of Prevention and Control of Dental Disease

The difficulties that would be encountered in performing dental treatment during space travel and exploration dictates the necessity that those involved in space travel learn and practice a program of prevention and control of dental disease.

The concept that dental disease can be prevented and controlled is not new. The literature contains many publications regarding philosophy and technics of prevention.

The objective of this literature review was to accumulate information that might be used to formulate and execute a practical program of prevention of dental disease for those involved in manned spacecraft travel.

The literature considered pertinent for this objective was abstracted, categorized, and arranged alphabetically by author within the following headings:

- I. Early Research in Preventive Dentistry
- II. Surveys in Dental Health (caries prevalence, hygiene status)
- III. Dental Caries and Periodontal Disease (cause and prevention)
- IV. Patient Education and Motivation
- V. Oral Hygiene Technics
- VI. Toothbrushing (brush design and comparisons)
- VII. Fluorides

VIII. Oral Irrigation

IX. Adjuncts for Oral Health (floss, rinses, dentifrices)

X. Nutrition

# I. EARLY RESEARCH IN PREVENTIVE DENTISTRY

"The teeth can be cleaned well enough to prevent disease and to maintain reasonable oral cleanliness only by the proper use of the right kind of both toothbrush and dental floss.....The material to be removed consists of (a) food material of all kinds that may have been retained about the teeth since the previous cleaning, (b) microorganismal material that has grown and accumulated at these locations since the previous cleaning, or prior thereto.....The action of the brush is mechanical by which the material is broken up and dislodged by the digging action of the ends of the bristles when the brush is held firmly against the place to be cleaned and is moved back and forth, or from side to side, by several short strokes, so as to force the bristles into the pits, grooves and spaces as far as their diameter will allow them to go.....

Normally the edge of the gum rests upon the soft, smooth, non-irritating enamel cuticle. Bacterial material allowed to accumulate and remain at this location for long periods of time tends to produce a hard, rough incrustated material (calculus) which has the effect of a foreign body upon the gum, against which it rests, in place of the normal enamel cuticle. Irritation and inflammation of the gingiva at the entrance to the gingival crevice, microscopic at first, constitutes the very earliest stage of periodontoclasia.....The significance of this foreign body effect was recognized by Dr. John W. Riggs in 1876 who correctly asserted, at that time, that the early stage of suppurating inflammation (early stage of periodontoclasia) is caused by the accumulation of accretions and roughened surfaces on the teeth at the gingival margins..... An important function that is served by an appropriate toothbrush properly used, is to dislodge and remove the soft microscopic material at the entrance to, and within, the gingival crevice, to the extent that these are accessible to the application of the brush.....Characteristics of a good brush: (1) plain straight handle design; over-all length about six inches, width about 7/16 inch; three rows of bristles, six tufts to the row, evenly spaced. (2) High quality nylon bristles, about 80 per tuft, .007 inches diameter, straight trim, finished to 13/32 inches length. (3) Ends of bristles ground and finished to hemispherical shape or at least to eliminate all sharp points and rough edges. (4) A similar brush of reduced size for the use of young children should have an over-all length of about five inches, .005 inch bristles, finished to 11/32 inch length."

BASS, C.C. Optimum characteristics of toothbrushes for personal oral hygiene. D. Items of Interest 70:696-718 July 1948.

"Proper use of dental floss is necessary to clean the considerable area on the proximal surfaces of teeth, which cannot be reached by the bristles of the toothbrush.....I have shown that the film of bacterial material beneath which caries begins and progresses consists principally of fili-



## EARLY RESEARCH IN PREVENTIVE DENTISTRY

2

mentous types of organisms. One end of the organism is attached to the enamel cuticle from which it extends outward toward the surface of the film.....Food material, when lodged and retained upon the continuously present filamentous bacterial pad is rapidly decomposed. If favorable carbohydrates are present, acids are produced. The bacterial pad is commonly called 'materia alba.' .....The purpose of the use of dental floss, so far as caries and personal oral cleanliness are concerned, is (a) to dislodge and remove any decomposing food material that has accumulated at the proximal surfaces since the previous cleaning and which cannot be reached and removed by the brush, (b) to dislodge and remove as much as possible of the growth of filamentous and other organisms that has accumulated in these protected caries susceptible areas, since the previous cleaning.....The lesion of periodontoclasia begins at the gingival margin and is initiated by the irritation and inflammation of the marginal gingival tissue by compacted and encrusted bacterial material on the enamel cuticle.....Characteristics floss should have: (1) material - high tenacity bright nylon yarn 'type 300', two denier per filament. (2) construction - made by twisting five threads of 70 denier, 3/4 filament yarn. (3) twist - 3S twist, steamset. (4) size -350 total denier."

BASS, C.C. Optimum characteristics of dental floss for personal oral hygiene. D. Items of Interest 70:921-934 Sept. 1948.

"The purpose of this paper is to report the frequency of the presence of Leptothrix racemosa, based upon fruiting heads of this organism in cavities in a miscellaneous collection of extracted tooth specimens. Fruiting heads of Leptothrix racemosa were found in 76 percent of the open cavities in permanent tooth specimens and in 84 percent of those in deciduous molars."

BASS, C.C. Leptothrix racemosa in open cavities. J.D.Res. 34:621-625 Aug. 1955.

"The purpose of this paper is to call attention to this serious deficiency in dental education; also to urge responsible leaders in this important field of human health-welfare to investigate this matter and get the facts in this regard for use of the information as they wish to make of it in the future.....Both caries and periodontoclasia are caused by microscopic organisms. Measures to prevent early stage caries must be designed to prevent or minimize accumulations and retention of bacterial film (plaque) at the particular location.....Periodontoclasia is a universal disease of man, originating in childhood and never ending as long as the individual has any teeth left."

BASS, C.C. Personal oral hygiene; a serious deficiency in dental education. J. Missouri D.A. 43:18-22 Dec. 1963.

"The first proposition not heretofore generally recognized is that a colloid precipitate, inspissate, or agglutinating substance must first be formed and deposited upon the teeth, or other solid substance, before there can be a lodgment of the calcium salts. Then the precipitated particles lodge in this material. It is not soluble in running water, warm or cold. It coagulates and becomes white like the cooked white of an egg at, or near 200° F.....When freshly deposited, it is slightly sticky to the fingers. It is readily broken up and washed away with a brush and water.....A deposit six to twelve hours old will not wash away in running water, warm or cold, within a few minutes or in half an hour, but is easily broken up and removed with the brush. If it is 24 hours old, it is not removed so easily; when two days old, its removal becomes difficult. When a week old, it cannot be removed with a brush and water. It has become too hard, too firmly adherent. This kind of examination is of great importance in becoming acquainted with the necessary care in keeping the teeth, or any plates worn in the mouth, clean.....Cleaning the teeth has, in our artificial methods of living, become essential to the health of the tooth and the gingivae. A few persons are found who have teeth and gingivae of such excellent forms, and who use their teeth so vigorously that the natural cleaning by the excursions of food over them seems fully sufficient for their purposes. Their teeth will be found clean and free from lodgements, no matter when they are examined. In these cases the good, natural forms are probably efficiently aided by a quality of saliva that readily dissolves any food particles that cling to the teeth and do not themselves precipitate any of their colloids.....But this is not true of the large majority of persons. Artificial cleaning is essential for both children and adults. This cleaning should for the most part be done with the toothbrush and syringe - other aids such as the toothpick, silk floss, rubber bands, etc., also have their place. It should begin with the child and continue practically through life as one of the essential elements of personal care for health and comfort.....In order that the dentist may prevent grave disease affecting the attachments of the soft tissues to the teeth of patients for whose welfare he is responsible, he must be forever looking for the beginnings of these troubles.....The particular thing looked for will be over-fullness of the gingivae in children and young persons in general. In older persons such points of redness, and swelling of the septal tissue, even though slight, will often disclose grave conditions, or imminent danger that such will occur, caused by the impaction of food between certain teeth that requires immediate treatment of the most vigorous kind, especially as to cleanliness, to prevent destruction of the tissue."

BLACK, G.V. Beginnings of pyorrhea alveolaris, treatment for prevention. Dent. Items Interest 33:420 June 1911.

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Parmly referred to as the "Father of Oral Hygiene". It was he who discovered the cause of dental caries and anticipated W. D. Miller by exactly 70 years. Granting that others before him had suspected or guessed the same cause, no one else had stated it so clearly and so positively as he did in his book, A Practical Guide to the Management of Teeth, comprising the discovery of the origin of caries, or decay of teeth, published in 1819. The following direct quote will convey his ideas: "The great and leading cause of the diseases of the teeth and gums, is to be sought for in the exercise of their functions. Being the agents of introducing the supplies to the system, they must act on these supplies mechanically, and fit them for passing into the stomach; and in doing so, part of that matter, of which the supplies consist, must adhere, and receive, if allowed to remain, that change which enables it to act upon, and erode their enamel and bone; and contribute to that peculiar secretion on teeth, known by the name of tartar, which is another cause of inflammation and disease of the gums. This is the true source of caries, or decay of the teeth." ..... "I can, with confidence, assert, that if the teeth and gums are cleaned regularly, no caries can possibly take place." Parmley also discussed cleansing methods and mentioned that floss (thread) is the most important item.

BREMNER, M.D.K. Levi Spear Parmly - The Pioneer Discoverer of the Cause of Dental Caries. Dent. Items Int. 75:154-159 Feb. 1953.

"Young persons should be urged to keep their teeth very clean, and the daily use of a toothbrush, with water only, will in most cases be quite sufficient. In addition to the use of the brush, great advantages may be derived from the employment of waxed floss silk, as recommended by Dr. L.S. Parmly.....In this way the impurities that cannot be reached with a brush, are removed from between the teeth, and which, when permitted to remain, cause their decay. If it were possible to keep the teeth thoroughly and constantly clean, they would never decay."

FOX, J. The natural history and diseases of the human teeth. Philadelphia, Ed. Barrington and Geo. D. Haswell 1846, p. 173.

"If too hard a brush is used, it irritates the gum, and sometimes, particularly if some gritty dentifrices are employed with it, denudes the necks of the teeth and causes their early loss."

GODDARD, Paul B. The anatomy, physiology and pathology of the human teeth. Philadelphia, Cary & Hart, 1844, p. 133.

"This hygienic apparatus consists of a bulb with multiperforated point, designed for the purpose of flushing the gums and irrigating the teeth

## EARLY RESEARCH IN PREVENTIVE DENTISTRY

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with water or any antiseptic mouth wash and may also be useful as a chip blower."

GOSLEE, H.J. Art and invention, Report of the Committee. Dent. Dig. 8:744, Sept. 1902.

"In the few hundred years of modern dentistry, each of the outstanding 'giants' of the dental profession have focused their attention upon the problems of mouth hygiene - often proposing better methods than previously available. Pierre Fauchard, John Hunter, G.V. Black and John Riggs are a few of those great pioneers who wrote on the subject of oral hygiene. The work of a physician, Dr. C.C. Bass, is particularly noteworthy. He brought to the dental profession concepts of plaque control which we use today. The major thrust during recent years in dental disease control has come from the research of Dr. Sumter Arnim, who studied with Dr. Bass, examined the microbial masses which collect upon the teeth in areas which are not properly cleaned. He called these masses of bacteria, their products, and the acquired gel that binds this material along with epithelial cells and blood cells, a microcosm."

HATTLER, Arthur B. and Summers, Robert B. What you should know about bacterial plaque. Pennsylvania D.J. 38:16-19 July 1971.

Kells, after using flushing machine: "I too could truthfully say, my mouth had never felt so clean before.....This was a revelation to me because I had been under the impression that in view of the thoroughness with which I used a wash, tape, brush and dentifrice my mouth always had been pretty clean, but having been convinced to the contrary, the next logical step was to devise a machine I could use at home."

KELLS, Edmund, Jr. The "last cry" in the care of the teeth. Oral Hyg. 3:921-925 Nov. 1913.

Levi Spear Parmly August 29, 1790 - July 8, 1859. "Parmly firmly believed all diseases of gums and teeth could be prevented by keeping the mouth thoroughly clean, and to this end he invented his dentifrice apparatus which if used correctly, would rid the mouth from all offensive and irritating matters." (Parmly's apparatus consisted of: Brush, Polisher, Prepared silk, glasses for examining.)

LOTT, Wayne H. Personal oral hygiene - one man's way of life. Ark. D.J. 35:7-9 Sept. 1964.

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Levi Spear Parmly 1790-1859, teacher of preventive dentistry. Cleanliness of teeth became his life's work. He said, "A thread passed between the teeth after every meal will save more teeth from decay than all brushes and powders that can be used where the waxed thread is neglected."

LOTT, Wayne. Levi Spear Parmly - first apostle of oral hygiene. Arkansas D.J. 38:13-18 June 1967.

"The writer has for many years been in the habit of employing an atomizer for applying the antiseptic lotions or mouthwashes in the treatment of these oral conditions. The patient is instructed to thoroughly brush the teeth after each meal, then to pass floss-silk between all of the teeth, and follow this cleansing process with the atomizer, using sufficient force to drive the antiseptic fluid through the interdental spaces. If by the end of a week the gums have not assumed their normal color, or there is still a discharge of pus from any pocket, the chances are that a small adherent scale of calculus still remains. This should be searched for and removed and the case treated as before."

MARSHALL, John Sayre. Principles and practice of operative dentistry. Philadelphia, J.B. Lippincott Co. 1901, p. 548.

"To every one at all acquainted with the nature of that condition of the teeth denominated as decay, caries, etc., and with the causes by which it is produced, it must be apparent that there are four ways by which we may counteract or limit the ravages of this disease. We may endeavor (1) by hygienic measures to secure the best possible development of the teeth; (2) by repeated, thorough, systematic cleansing of the oral cavity and the teeth, to so far reduce the amount of fermentable substances as to materially diminish the production of acid, as well as to rob the bacteria of the organic matter necessary to their rapid development; (3) by prohibiting or limiting the consumption of such foods or luxuries which readily undergo acid fermentation to remove the chief source of the ferment-products injurious to the teeth; (4) by the proper and intelligent use of antiseptics to destroy the bacteria, or at least to limit their number and activity.....That a great influence is exerted upon the process of fermentation in the human mouth by the mechanical cleansing mentioned may be easily proved by the following experiment: Take 10.0 c.cm. saliva from the mouth in the morning before cleansing it, add 0.5 gr starch, and place the mixture in the incubator. Then cleanse the mouth and teeth most thoroughly with the brush, toothpick, floss silk, etc. after which take 10.0 c. cm. again (easily obtained by chewing a quill toothpick.....), add 0.5 gr. starch as before, and place also in the incubator. The first mixture not only shows signs of fermentation sooner than the second, but also forms much more acid in a given time. That different kinds of foods and luxuries

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play vastly different roles in the fermentations of the human mouth must be apparent to every one from the table given on pages 208-209. The substances which give rise to fermentation in the mouth accompanied by the development of acid, belong almost without exception to the group of the carbohydrates.....Most authors give sugar the chief place among foods which exert an injurious action upon the teeth - again a conception which is not quite right.....In general, however, the chief role in the production of decay is performed by bread, potatoes, etc., not only because they produce more acid, but because they, on account of their insolubility, may remain for a long time sticking to or between the teeth, whereas the readily soluble sugar is soon diluted or carried away. In my opinion, sugar can equal bread in its destructive action upon the teeth only when it is consumed as an ingredient of sticky, insoluble substances.....I lay no particular value on tooth-powder as a means of cleaning the teeth. It is true that the external surfaces particularly of the front teeth, may be kept whiter by the use of tooth-powder, but the centers of decay are more liable to become stopped up than to be cleaned by tooth-powder, particularly when they contain insoluble constituents. Somewhat more recommendable I find the tooth-soaps, in so far as they dissolve fatty substances without attacking the teeth, and furthermore, possibly make the penetration of the bristles of the toothbrush into the center of decay somewhat more easy. They should be made of neutral soap, and have a neutral or slight alkaline reaction. Under all conditions, however, the chief thing is the thorough mechanical cleansing of the teeth.....If a very thorough mechanical cleansing has not preceded the antiseptic (mouthwash), its action upon the centers of decay will be equal to a little more than zero.....It follows that the use of the mouthwash should always be preceded by the thorough use of brush or toothpick, removing at least all larger particles of food and opening the spaces between the teeth, so that the wash may penetrate to the vulnerable point."

MILLER, Willoughby D. The micro-organisms of the human mouth. Philadelphia, The S.S. White Dental Mfg. Co. 1890. 364 pgs.

"The teeth of the savage are generally sound and regular, and no accumulation forms to deface them. But this is different in civilized society; refinements in the culinary art give the food a greater tendency to acquire noxious powers, and form a chemical combination. This is displayed by the formation of extraneous matter, called tartar, which, as it accumulates, separates the teeth from their chief support, the investing membranes of the gums, and thus loosening them in their sockets, exposes them, and produces inflammation. But a more active cause of the premature loss of teeth is the accumulation or lodgment of food in their interstices. There the putrefactive process commences, acts upon the enamel and penetrates to the bone. In this way, the tooth becomes gradually destroyed, and the individual suffers successive inflammation and pain for a time, till this active

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monitor, that leads to attention in all cases, speaks in a language not to be misunderstood, the mischief of neglect....."The first part to be used is the brush.....surfaces are completely freed from all extraneous matter. The second part is the dentifrice polisher for removing roughness, stains.....The third part is the waxed silken thread, which though simple, is the most important. It is to be passed through the interstices of the teeth, between their necks and the arches of the gums, to dislodge that irritative matter which no brush can remove, and which is the real source of disease. With the apparatus thus regularly and daily used, the teeth and gums will be preserved free from disease....."

PARMLY, L.S. A practical guide to management of the teeth comprising a discovery of the origin of caries for decay of the teeth with its prevention and cure. Philadelphia, Collins & Croft, 1819, p. IX.

"After more than 30 years experience in dental surgery, and minute observation, I am confident that the gums and teeth of every individual may by proper and daily friction continue in perfect health, independent of all other organs of the human structure, and fulfil the benevolent designs of nature in masticating the food to the most extreme old age..... I consider the inflammation of the gums, the decay and loosening of the teeth as entirely the result of neglect by allowing foreign matter, fluid or solid, to become filthy, corrosive and destructive in quality, and then remaining in contact night and day, producing a chemical decomposition of the enamel before it is polished".....The following instruments recommended by Parmly: "(1) A stiff brush of suitable size used freely over the crowns and gums at the same time. (2) Floss silk well waxed should be passed up and down on the right and left side of each tooth, a little under the gums, which will remove all accumulations from the interstices and necks of the teeth where the brush cannot reach. (3) The tooth-polisher formed so as to be applied to the surface of the tooth where any discolorations may be seen, and near the gums or edges. (4) The double instrument for removing hard tartar and separating the gums during the growth of the teeth so as to make room to polish and clean the enamel thus exposed, and where the ordinary means cannot be applied with good effect. (5) The tongue scraper, of whale bone, should be used every morning at least to free the surface and edges of the tongue from foul deposits, and discharge the glands and remove secretions from the mouth."

PARMLY, L.S. Dissertation on the management of the mouth and teeth. Am. J. of Dental Science 2:28-38 Sept. 1841-1842.

G.V. Black - "The Father of Modern Dentistry." Black in his own way educated himself and became dentistry's leading scientist. W.D. Miller, a friend of Black's kept him well informed on the study of microbiology. Black studied diseases of the mouth and made observations on the influence

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of acid or alkaline conditions upon the teeth. He studied tissues and microscopic slides of his own. He made almost all his instruments. In 1883, he prepared his first book, The Formation of Poisons by Microorganisms. He was first to announce that all life, including microorganisms, produce injurious waste products and that they are largely responsible for disease, including dental caries. In 1890, appeared the first edition of his Dental Anatomy. In 1891, the Dental Cosmos published five of his articles on "The Management of Enamel Margins," in which the phrase, "extension for prevention" appeared and a phrase which has become part and parcel of scientific cavity preparation.

SCHEWE, E.F. G.V. Black - Man of the centuries. Wash. Univ. D.J. 16: 134-139 May 1950.

"Microbic plaques and small granules of calcific deposits are transparent, or so nearly of the color of the teeth that they are frequently invisible to the eye. The sense of touch, after months of experience with a hand polisher or orange wood stick will only imperfectly indicate to us whether or not a surface is clean, so that the only means of absolutely proving whether all foreign substance is removed from surfaces not covered by gum tissues is the use of a disclosing solution."

SKINNER, F.H. The prevention of pyorrhea and dental caries by oral prophylaxis. D. Cosmos 56:299, 1914.

"Dr. Parmly (in approximately 1819) assigns as the cause of caries the accumulations of debris around and about the teeth and from the corrosive action of acid in the saliva, and advises as a means of prevention scrupulous care to keep the teeth and their surroundings clean. It is said of him that he would stop a boy on the street or elsewhere, look over his teeth, give him a lecture on their care and a toothbrush and floss silk, all the while explaining to him their use."

THORPE, Burton Lee Levi Spear Parmly, D.D.S. - A pioneer author and apostle of dental hygiene. Dental Brief 9:207-214, 1904.

"Pickerill, in 1918 said: "It is at the very surface of the enamel that the battle is won or lost.....it cannot be too strongly emphasized that the fight is at the surface - the surface being breached, in 99 percent of cases total defeat is certain."

TUCKFIELD, W.J., Editor. Mechanism of fluorides in caries control. Aust. D.J. 14:339, Oct. 1969. (Pickerill, Dental Research 38:27, 1918)



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"Dr. Black was born August 3, 1839, and started his professional career by studying medicine under his older brother; then he spent a year in the dental office of Dr. J.C. Speer, his preceptor, at Mount Sterling, Ill. These years constitute his only formal professional training and in view of his later greatness, add to his stature.....For twelve years prior to 1895, Black experimented with the amalgam that had previously been renounced until he had worked out the balanced alloy amalgam which was widely accepted.....In 1908, Black's monumental work, Operative Dentistry, appeared in two volumes, which work was the magnificent culmination of his long labors. In 1897, he became Dean of Northwestern University Dental School, and in this capacity he served for 17 years. He became the foremost leader in dental education and helped build one of the leading dental schools in the world."

AUTHOR UNKNOWN: Notable contributions to fifty years of progress 1900-1950:- G.V. Black. J.A.D.A. 40:720-721 June 1950.

## II. SURVEYS IN DENTAL HEALTH: (Caries prevalence - hygiene status)

Survey conclusions: "Two hundred two questionnaires obtained from a geographic distribution of dental patients in North Carolina were evaluated in terms of oral hygiene practices and possible motivational factors involved in oral hygiene. Seventy-seven percent brushed teeth twice daily. Fifty-four percent had been given oral hygiene instructions, but only 11 percent used auxiliary hygiene aid, but mostly not on recommendations of dentist. Mouth wash and toothpicks were most frequently used. Patients who had the most frequent dental appointments were likely to be the most highly motivated as determined by frequency of brushing. This helps emphasize the value of a sound recall system. More emphasis needs to be placed in the dental office on the rationale for brushing as well as the technique of brushing. Most subjects had not been told to obtain a new toothbrush (nor had they been given one), had not had their hygiene efficiency appraised following instruction, had not used disclosing tablets, and had not been told that their hygiene could be improved. All of these, if properly used, can be positive motivating factors to help a patient develop a better oral hygiene habit pattern."

ALLEN, Don L. Oral hygiene practices of dental patients in North Carolina. J.N.C.D. Soc. 52:16-23 April 1969.

"Survey by means of questionnaire carried out in 1967 in Dublin Dental Hospital to determine oral hygiene practice of staff, students and dental auxiliaries. Comparison made of frequency and times of brushing; further comparisons are made according to sex, age, tooth loss and the wearing of prosthetic appliances. The only firm conclusions that can be drawn is that most people are not convinced that the benefits to dental health of careful oral hygiene practice are worth the effort."

ALLWRIGHT, Walter C. Oral hygiene practice in Dublin Dental Hospital. J. Irish D. Assn. XIV:97-103, Oct.-Nov. 1968.

"Caries experience of 12,344 school children, ages four to nineteen, were studied. Article includes many charts and illustrations and extensive summary and includes: "high and early tooth mortality was shown to be a consequence of a rampant smooth-surface caries affecting highly deficient tooth structures of "yellow teeth". The coincident survey of nutrition suggested that the abandonment of ancestral food habits and their replacement by a diet of refined carbohydrates were responsible for this outbreak of rampant decay. Comparison with other studies made among Polynesian populations showed the culmination in Tahiti of a general trend toward an increasing dental deterioration which has been brought under control in the case of the Maoris of New Zealand and the Hawaiians."

BAUNE, I.J. Caries prevalence and caries intensity among 12,344 school children of French Polynesia. Arch. Oral Biol. 14:181-205, Feb. 1969.

## SURVEYS IN DENTAL HEALTH

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"Study made to determine oral hygiene status of racially mixed population. Patients had been examined and had received prophylaxis in the Division of Dental Hygiene during period of 1961-1964. Dental charts of 1,040 patients were examined for the "class of prophylaxis" assigned. Three classes of prophylaxis (Class I, II and III) are used at Meharry and are based upon nature of deposits present and relative proportion of tooth surfaces covered by them. All surfaces of all teeth are examined. The "class of prophylaxis" was used as an index of the relative oral hygiene status. Oral hygiene status was assessed as "good", "poor", "very poor". Five hundred eighty-two males and 458 females. Ages ranged from three to 85. Although orientals and caucasians were included, the largest ethnic group was Negro. There was an inverse relationship incidence of "good" oral hygiene status and age. As age increased, the incidence of "good" oral hygiene decreased. Sex and racial differences in oral hygiene status were not marked."

BENNETT, W. L. and Seibert, W.J. Evaluation of oral hygiene status of clinic patients. IADR Abstracts, 1965.

".....One study was made in which oral health changes among two troop populations provided clinical oral health care in keeping with the earlier described treatment planning concept were compared with changes among two troop populations provided with conventional, or pre-preventive concept care. Results indicate significant advantages for the "preventive group" as measured by numbers of new decayed, missing and filled teeth, and as measured by periodontal health debris and calculus index scores. Calculus control was especially effective for the "preventive group". In another study, periodontal and oral hygiene index scores of several hundred troops were found to have a reverse correlation with reported tooth-brushing frequency, attesting to the importance of oral hygiene instruction. Still another study of one months' duration demonstrated that cleaning the teeth with either a soft balsa wood stimulator or with toothbrush and dentifrice was substantially more effective in maintaining oral hygiene than was mouth rinsing, and presumably even more effective than performing no oral hygiene measures.

BERNIER, Joseph L. The dentist and preventive dentistry. J. District of Columbia Dental Soc. 44:6-8, Jan. 1969.

".....The Army population is approximately two million.....To care for the dental needs of these people would require approximately 12 million man hours. The Dental Corps contains 2500 dentists who, if they worked 24 hours per day, seven days a week, could supply only four million man hours per year.....The size of the Dental Corps cannot be increased since the ratio of one dentist to 500 is already four times better as the average civilian ratio of one to 2000.....The only solution is in the area of PREVENTION....."

BERNIER, Major General Joseph. Periodontic and prevention needs in a large population. Periodontal Abstracts - The Journal of the Western Society of Periodontology XVII:10-11 Mar. 1969.

## SURVEYS IN DENTAL HEALTH

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SUMMARY: "1) The object of the study was twofold-a) to assess caries activity using Snyder saliva tests and caries incidence in ten subjects at Stonington Island base over a period of eleven months, and to study the dietary and environmental factors which may have influenced these findings. b) To observe the dental status of all personnel who had spent one or two winters in Antarctica. In the Stonington Island group there was found to be an average increment of six and four-tenths cavities per head over the eleven month period. Serial Snyder tests showed a steadily increasing result as the winter progressed, although field activities caused a marked reduction in salivary acid production. In the 30 subjects who had spent one or two winters in Antarctica there was a mean increment of five cavities per head."

BEYNON, A.D.G. Some observations on dental caries in a polar environment. The Dental Practitioner 19:375-378 July 1969.

"SUMMARY: Chewing tests using an iron tracer biscuit were carried out on 52 children (13 years old) and the oral debris retained correlated with the clinical conditions in the mouth. The results showed that both gingivitis and lack of tooth cleanliness were very significantly related to the debris retention."

BIRCH, R. H. Tracer biscuits and debris retention. Brit.D.J. 124:267-270 March 19, 1968.

"Official agencies estimate that about 45 percent of our population visits the dentist at least once a year, for whatever reason. Casual estimates indicate that only 20 percent receive optimal, continuing care. It is the purpose of this report to review the reasons for the gap and some of the ways to bridge it."

BROWN, William E. The dental diseases - their magnitude, prevention, and treatment. J. Am. College of Dentists 37:35-41 Jan. 1970.

Summary: "Details are given of dental data collected during a socio-dental survey of samples of the populations of two contrasting towns, Salisbury and Darlington. Particulars are presented of the equipment used in the survey, of the dental team personnel and of the examination methods and criteria. Measures of dental, periodontal and prosthetic conditions encountered are reported with reference to age, sex and social class. In Salisbury two of every three persons in each town had either partial or full dentures, of those with some of their own teeth still present, 96 percent in Salisbury and 90 percent in Darlington were found to need some form of dental attention."

BULMAN, John S., Slack, Geoffrey L., Richards, N. David, Willcocks, Arthur J. A survey of the dental health and attitudes toward dentistry in two communities. Part 2. Dental Data. Brit.D.J. 124:549-554 June 1968.

## SURVEYS IN DENTAL HEALTH

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"In Malayan children odontoclasia is almost always initiated on the smooth labial surface of the gingival half or two-thirds of the upper anterior deciduous teeth in areas in which ordinary dental caries is seldom initiated. On the other hand the affected enamel of the deciduous teeth that is involved in odontoclasia is that which is formed before and shortly after birth.....The portions of the teeth most susceptible to "odontoclasia" are those in which the neo-natal line forms and in tissues formed for some months thereafter. It would appear that enamel and dentin formation is sufficiently disrupted at birth and for some time thereafter to make it extremely susceptible to decay even if there is no clinical evidence of enamel hypoplasia. The general insusceptibility of the lower anterior deciduous teeth to odontoclasia is difficult to explain, for it would seem that some of the enamel and dentin of the lower deciduous teeth would form at the same time and be subject to the same deficiencies as the tissues of the upper deciduous teeth. Hence, it would be expected that some of the upper and lower anterior deciduous teeth would have equal susceptibility to odontoclasia, but the lower teeth are relatively insusceptible. A possible alternative explanation would be that the enamel and dentin of the upper and lower deciduous teeth of malayan children do not form at the same time."

BURNETT, George W. and Moriera, B.J. Rampant dental caries or odontoclasia in Malaysian children. Dental J. of Malaysia and Singapore 9:45-50 Oct. 1969.

"The racial variations in caries and periodontal disease among 9,912 children of ages twelve to 18 years in public schools of Hawaii were studied after allowance was made for the effects of other epidemiologic factors. Racial effects were studied by use of an extended model of diallel cross, taking advantage of 267 observed racial combinations. Caries was measured by DMF teeth, DM/DMF ratio, and caries-freeness. Periodontal disease was scored by the PI. Caries was more prevalent among children of Japanese, Korean, or Hawaiian parentages, followed by Chinese. Children of Caucasian, Puerto Rican, or Filipino origin had the lowest level of caries experience. There was no evidence of the effects of maternal influence, hybridity, or genic recombination, which indicates that cariogenic factors are primarily acting additively in the racial crossing. The numbers of caries-free individuals were in proportion to the general levels of caries experience among races. With the variation of oral hygiene taken into consideration, children of Hawaiian ancestry had a distinctly higher prevalence of periodontal disease than other racial groups. Further there was a significant effect of the hybridity of the child when major racial crosses were involved, which suggests an important role of recessive gene(s) in causing higher risk in periodontal disease."

CHUNG, C. S., Runck, D.W., Niswander, J.D., Bilben, S.E. and Kau, M.C.W. Genetic and epidemiologic studies of oral characteristics in Hawaii's school children: I. Caries and periodontal disease. J.D.Res.(Jrnl. is part 2 of 2 parts) 49:1374-1385 Nov.-Dec. 1970.

## SURVEYS IN DENTAL HEALTH

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"An examination of 613 Regular Army troops and 117 National Service conscripts was made in 1965 and 1966 to discover prevalence of periodontal disease and dental caries and to correlate findings with oral uncleanness. Troops were age 17 to 29 years, Servicemen were all aged 20 years.....This study on periodontal disease in young Australians has confirmed the relationships observed in other parts of the world.....As elsewhere, the severity of the disease increases with age, and ORAL HYGIENE is the most important single feature associated with the disease. Even in the older age groups, patients with lower oral hygiene Index showed correspondingly lower Periodontal Index...."

DALE, John W. Prevalence of dental caries and periodontal disease in military personnel. Australian D.J. 14:30-36, Feb. 1969.

SUMMARY: "Regular Army and National Service soldiers between 17 and 29 were examined and their dental conditions and toothbrushing frequency were recorded. All were found to be universally affected with dental caries and periodontal disease. Toothbrushing frequency was found to be significantly related to oral hygiene and periodontal disease, the more frequent brushers having better hygiene and periodontal conditions. Oral hygiene was not correlated to decayed teeth or caries experience, but the more regular toothbrushers showed lower mean numbers of decayed teeth. Oral hygiene has been shown to be the most important single factor in periodontal disease and it has been shown that through correct toothbrushing, oral debris can be kept minimal."

DALE, John W. Toothbrushing frequency and its relationship to dental caries and periodontal disease. Aust. D.J. 14:120-123 Apr. 1969.

Three thousand four hundred and fifty-two persons were located and tested.....The most consistent and striking association with severe periodontal disease is level of oral hygiene.

DUNBAR, J.B., Wolff, A.E., Volker, J.F. and Moller, P. Survey of human periodontal disease in Iceland. Arch. Oral Biol. 13:387-405 April 1968.

"In investigating this selected sample of referred patients (350) we had expected a relatively high level of oral hygiene activity and instruction. From this point of view the results are disappointing. Remembering that 84 percent of the sample claimed to be in regular contact with a dental practitioner at intervals of up to one year and that all had been referred for the treatment of the full spectrum of established periodontal disease, it is important to note again that only 35.4 percent claimed any instruction in toothbrushing, 29.0 percent any recommendation in toothbrush type, and only 12 percent used interdental sticks daily.....In addition 43.6 percent of the sample had their toothbrush for three months or longer. The authors suggest that a brush retained for this long will frequently show sufficient wear to reduce its efficiency.....Also, these findings

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suggest females generally show a greater motivation towards adequate oral hygiene than males, a conclusion which should again be of use in compiling oral hygiene programmes.....If periodontal disease is to be controlled on a wide scale the formulation and dissemination of a realistic oral hygiene instruction must be of a primary occupation of the profession.....Despite a claimed high level of dental attendances, advice on specific aspects of oral hygiene does not seem to have reached the majority of the group. Presumably groups with worse attendance records or where periodontal disease is undiagnosed will receive even less advice. If periodontal disease is to be controlled on a wide scale the formulation and dissemination of realistic oral hygiene instruction must be a primary occupation of the profession."

EDWARDS, M.B. and Strahan, J.D. Oral hygiene activity in a selected dental population. The Dental Practitioner and Dental Record 21:312-316 May 1971.

"A clinical dental health survey of 995 children and young adults in various institutions in the Sudan is reported. The results show that chronic periodontal disease was prevalent and was closely correlated with poor oral hygiene.....Study confirms that teeth are well formed and more resistant to decay in areas with fluoride content of the communal water supply which may cause the earliest signs of clinical mottling.....There is little dental caries in the Sudan, but this is higher in Khartoum area where there is a higher consumption of refined sugar."

EMSLIE, R.D. A dental health survey in the Republic of the Sudan. Brit. D.J. 120-167-178, Feb. 15, 1966.

"A survey of 218 out of the total population of 225 inhabiting the island of Tristan da Cunha was carried out, and the findings compared with those of previous studies in 1932, 1937, 1962, and 1966. It was found that the increase in the prevalence of dental caries shown in previous studies was continuing. The incidence of marked deposits of calculus and abundant food debris had increased appreciably from the level revealed in the 1962 survey, and established periodontitis was also more prevalent. In the over 40 age group, 82 percent of the men and 45 percent of the women showed severe periodontitis. In the whole adult population 45.3 percent demonstrated a lesion more severe than a gingivitis. Young people between the age of 13 and 19 years had clean mouths as assessed by the observer, but nevertheless the gingival state was graded as poor in 25 percent of this group. The observations had been conducted in each survey by different individuals whose ratings had not been correlated. The author states that the increase in caries is attributable to consumption of a more sophisticated diet, though an explanation for the increased prevalence of periodontal disease is not offered."

FISHER, F.J. A field survey of dental caries, periodontal disease and enamel defects in Tristan da Cunha. Brit. Dent. J. 125:447-453, 1968. (Abstract from Periodontal Abstracts. J. Western Soc. of Periodont. XVII:17 Mar. 1969)

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Results: Some 400 contestants were examined from 30 countries (Tables II-IV), and of these 50 were discarded because of insufficient numbers seen from the team. These numbers compare with a total number of participants given as 7,530, from 101 countries. All except a very few countries, especially the African, had large numbers of participants with gross caries. Although oral hygiene standards were not high, and there was a majority with early gingivitis, there was little advanced periodontal disease.....Conclusions: It seemed an inescapable view that a completely caries-free mouth is not necessary for full physical fitness, or for attainment of Olympic prizes. It is equally certain, however, that a dentally unfit mouth is a risk in that a crisis might occur at any time and will then jeopardize the contestants' chances. One must conclude that before the Olympics, medical officers were not of the opinion that dental fitness was of any importance with regard to the health or the prowess of the team members. ....Note: article ends with eight recommendations regarding dental fitness requirements.

FORREST, J. O. The dental condition of Olympic games contestants - a pilot study, 1968. Dental Practitioner 20:95-101 Nov. 1969.

"The potential clinical value of a modification of the Snyder test was evaluated in 150 kindergarten children over a four year period. The oral flora was sampled by swabbing the buccal surfaces of the teeth with a cotton tipped medical applicator which was incubated in a semifluid Snyder type medium. Test readings were made by a colour comparator or pH meter. The validity of this swab test, especially when related to previous caries treatment, is such that the difference in probability of developing new carious lesions in the following year is tenfold. Experimental error and the inter and intra day variation of the test results for individuals are reported. Some preliminary results concerning the nature of the organisms involved are also described. The swab test has practical clinical value in the dental office and in dental public health programs. The method as a whole provides a protocol for further epidemiological studies in the oral flora.....

TABLE I. Preparation of swab test medium:

Ingredients	Percent by weight	Per 1 litre batch
Difco Tryptone	2.0%	20 Gm.
Dextrose	2.0%	20 Gm.
Sodium chloride	0.5%	5 GM.
Agar	0.25T	2.5 GM.
Distilled water to 950 ml.	.02 Gm. or 50 ml. of aqueous soln.	
Lactic acid to yield pH of 5.0		1.8 ml. approx.
Sodium hydroxide if needed to correct pH		



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1) Bring ingredients to boil briefly and set out a few vials of clear medium for colour comparator controls before adding indicator. 2) adjust pH of medium to 5.0 by adding small amounts of lactic acid. 3) Dispense 2 1/2 ml. in (1) dram vials using an automatic syringe. 4) Autoclave for five minutes at 15 pounds pressure with caps slightly loosened. Tighten caps after they have cooled sufficiently to permit handling. 5) Label vials high up near cap so as not to interfere with the view of the liquid. Label clear vials with batch number so proper control can be used with the colour comparator. 6) Store in refrigerator if not required for a long period. Without refrigeration, shelf life at room temperature is some months. 7) If new glass vials are used they must be moistened with tap water, autoclaved and rinsed with distilled water to destroy strong alkali of new glass. Two and one-half cc. of the semi-fluid culture medium (Table 1) are dispensed in one dram vials with screw-type bakelite caps. The technique for taking the sample is as follows: 1) Stroke the buccal gingival areas of the teeth, in each of the four quadrants, once from the back to front with a sterile cotton tipped medical applicator. 2) Remove the cap from the vial of medium which should be at 37° C. or at least at room temperature and insert the applicator to the bottom of the vial. Rotate the applicator about five times, then raise and break off the stick against the lip of the vial. (Sticks will break easily if applicators are sterilized by slight browning with dry heat in an oven). Replace the cap and tighten firmly taking care not to contaminate the part of the applicator that is to stay in the vial, the lip of the vial, or the inside of the cap. 3) As soon as possible place vial upright in an incubator at 37° C. and leave for 48 hours. 4) After incubation make pH reading by a colour comparator or electric pH meter."

GRAINGER, R.M., Jarrett, M., Honey, Fergus and S.L. Swab test for dental caries activity: an epidemiological study. Canadian D. Assn. J. 31:515-526, 1965.

"Ninety-five Mexican-American children, ranging in age from five to 13 years of age and residing in Muscatine, Iowa were examined using the Simplified Oral Hygiene Index (OHI-S) and the Orthodontic Treatment Priority Index (TPI) to test the hypothesis that the children with the most severe handicapping malocclusions would also exhibit the poorest oral hygiene. An approximately equal number of males and females were divided according to age into three groups (5-7, 8-10), 11-13). The TPI and OHI-S scores for each child within a group were ranked so that the Spearman rank correlation coefficient could be calculated and tested for significance using the "t" test. There was observed to be no significant correlation between oral hygiene as scored by the OHI-S and occlusal disharmony as scored by the TPI."

GREWE, John M. Chadha, J.M., Hagan, Donald and Zermeno, Jorge A. Oral hygiene and occlusal disharmony in Mexican-American children. J. Perio. Res. 4:189-192, 1969.

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Summary: "A study of 68 patients in age groups from four to 30 showed 58 percent to have S. mutans as part of their oral endobiota. Both caries prone and caries immune individuals were culturally positive for this organism in approximately the same amount (60%). Cariogenicity, however, seems related to possession of a prophage since two out of two cultures from the caries prone patients had this phage while two out of two caries immune patients lacked it."

HARTLEY, Daniel P. and Graber, C.D. Incidence of Streptococcus Mutans in caries prone and caries immune patients in the Charleston area. So. Carolina D.J. 29:22-24, March 1971.

"Clinical control has clearly shown that in four large cities of Iran, 250 people examined in each, periodontal disease appears in nearly 100 percent of the population starting at the age of 14 years.....There is a significant correlation between the severity of periodontal disease and oral hygiene scores. With an increase in the periodontal disease score, the debris, calculus and OHI scores also increased."

HELD, Arthur J. A clinical survey about dental caries , periodontal diseases and oral hygiene in urban population in Iran. Parodontologie and Academy Review 1:159-192 Sept. 1967.

"A survey of 915 white children between 18 and 39 months showed 8.3 percent of 18 to 23 month old children had dental caries. The number of children having dental caries by 36 to 39 months increased to 57.2 percent. The average def teeth and def surface values for these latter children were 4.65 and 6.16, respectively.....Radiographic findings indicated that 75 percent of all posterior interproximal lesions would not have been detected unless radiographs were available."

HENNON, David K., Stookey, George K., Muhler, Joseph C. Prevalence and distribution of dental caries in pre-school children. JADA 79:1405-1414 Dec. 1969.

"The objective of study was to explore the possibility of a relationship existing between oral hygiene status and personality traits. One hundred randomly selected non-dentally oriented subjects were scored for plaque, crevice depth and PDI. After scoring, all subjects were provided with three personality inventories: Cattell 16 PF; Thorndike Dimensions of Temperament; California Personality Inventory. These inventories yielded 44 personality characteristics which have pervasive applicability to human behavior and related to positive aspects of personality rather than the pathologic. The direction of the study was not toward neuroticism or psycho-pathology, but to cover the main dimensions along which people can differ in accordance with basic factor analytic research. A statistical analysis of the data showed a significant correlation between plaque

scores and several of the 44 personality characteristics such as Thorndikes's TM factor and the flexibility and psychological mindedness assessment in the California Personality Inventory."

HOLDEN, Sally and Ash, Major M., Jr. Personality assessment and oral hygiene. IADR Abstracts, 1968.

"A previous study indicated that an increased individual educational level was indicative of a less severe periodontal disease and a better oral hygiene status, but may vary with the age and geographic residence of the individual in the continental United States. This investigation of 1,284 caucasian and Negro male subjects, aged 17-52, was made to further study the relationship of individual levels of formal education with periodontal and oral hygiene conditions. Variables of age and geographic origin were tested. Results obtained by computer analysis of linear regression, and differences between mean groups, considered a pair at a time.....Conclusions: 1) The socioeconomic factor of increased individual educational levels indicates improved oral hygiene status and less severe periodontal condition. 2) The age of an individual is a variable in relating individual educational levels with periodontal-oral hygiene conditions being most reliable in a 22 through 29 year age grouping. 3) The Northcentral region of the continental United States consistently indicates a relationship between the socioeconomic factor of individual educational level and periodontal-oral hygiene conditions. 4) Equivalents of socioeconomic factors must be considered in comparisons of population groups in analyses of periodontal-oral hygiene conditions."

HORTON, John E. and Sumnicht, Russel W. Relationships of educational levels to periodontal disease and oral hygiene: II. J. Periodont. 39:333-334 Nov., 1968.

"The distribution of dental caries (DF) is described by age-group, between right and left homologous mesial and distal surfaces of permanent maxillary incisors. In any age group above 15 years, and for any pair of homologous surfaces, the proportion of the population with an affected (DF) right surface, approximately equals the proportion with an affected left surface. The distribution of attacks between each pair of homologous surfaces was studied in individual mouths, by age-group. For each pair of surfaces, the ratio of the numbers of people with asymmetrical attacks, to those with symmetrical attacks, falls asymptotically to a value that remains almost constant during adult life. These data, in common with those obtained from an earlier study imply that caries resistant sites commonly occur on maxillary incisor teeth. The results are interpreted in terms of a new aetiological theory of dental caries."

JACKSON, D. and Burch, P.R.J. Dental caries: distribution, by age-group, between homologous (right-left) mesial and distal surfaces of human permanent maxillary incisors. Archives of Oral Biology 15:1059-1067 Nov. 1970.

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"This study concerns the dental condition of a community of children between the years 1950 and 1961. It appears that the prevalence of dental caries was considered to be the accumulated clinical caries score in existence at a particular time. Increment was used to express the frequency with which new carious cavities occurred. Restriction of dietary sugar affects the onset of caries markedly. The authors conclude, among other things, that dental problems are most severe in early life; and to be most effective preventive practices must be started at the earliest possible age and at the time of dietary changes."

JAMES, Peter M.C., Parfitt, Gilbert J. and Roydhouse, Richard H. Caries experience during a decade. J. Dent. Child. 37:17-23 July-Aug. 1970.

"Oral hygiene is a system of rules or techniques for the promotion of oral health which meet the objectives of preventive dentistry. It includes professional care, personal home care, and public health measures. Author refers to numerous studies which present evidence that support the concept that a system of oral hygiene can help prevent dental caries, gingivitis, and destructive periodontal disease. Surveys of brushing habits of both children and adults have shown that approximately 55 percent of population brush less than once a day and average 45 seconds per brushing, often with brushes that are no longer considered effective. Despite the demonstrated effectiveness of oral hygiene in preventing both caries and periodontal disease, less than twenty percent of practicing dentists routinely teach tooth brushing to their patients. The education of the public must begin early in the school system and be carried out until oral cleanliness is an established habit. This must be re-enforced in the private office. Continued effort may some day reduce the prevention of oral disease to a vaccine, pill, or mouth rinse. In the meantime, we should not overlook the benefit to be gained from the use of a simple device for the prevention of dental disease - the toothbrush."

LOBENE, R. The evaluation of oral hygiene in preventive dentistry. J. Mass. Dent. Soc. 15:158-164 Summer 1966.

"The purpose of the present study was to develop a method for short time caries trials in man, utilizing an experimental model already employed in periodontal research. Twelve students were given prophylaxis and instruction to practise meticulous oral hygiene, until their Plaque Index and Gingival Index approached zero. The carious state of the bucco-gingival enamel areas, excluding molars was evaluated at 16 times magnification, using a dissection microscope fitted with two spotlights. The cleaned and dried tooth surfaces were given a score according to a previously employed Caries Index, ranging from zero to three. The reproducibility for a single determination was found to be 0.4. Throughout the period of 23 days no active oral hygiene procedures were carried out. During this period six of the participants performed nine daily mouthrinses between meals, using ten ml. of a 50 percent sucrose solution. At the termination of this period the sucrose group demonstrated a higher mean. Caries Index and a greater number of new incipient lesions than the control group. The mean Plaque Index scores were 2.1 and 1.7 respectively, whereas the Gingival

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Index scores approach one for both groups. On the basis of smears of plaque no significant differences were observed in the percentage distribution of various types of microorganisms. After 30 days of meticulous oral hygiene and daily mouthrinses with 0.2 percent NaF, fair agreement was found between the Caries Index scores of the two groups. Similar observations were made after a second, comparable hygiene and fluoride period. The results demonstrate that it is possible to produce detectable carious alterations within 23 days by frequent sucrose intake in young individuals. Furthermore, the alterations seem to be reversible, since a definite improvement has been observed during a period of 30 days of good oral hygiene and frequent fluoride supplementation."

LOE, H., von der Fehr, F.R., and Theilade, Else. Experimental caries in man. Caries Research 3:206-207 1969.

SUMMARY: "The concentrations of trace elements in water samples taken from the homes or schools of caries-resistant Navy recruits from northwest Ohio have been compared with the content of public water supplies of the seven largest cities of Ohio, the cities in states where dental caries prevalence is least and where prevalence is greatest. Statistical analysis revealed significant differences in the concentrations of boron, lithium, molybdenum and strontium and the suggestion is that these elements in conjunction with fluorine, may be instrumental in reducing dental caries. There are some indications that the intake of trace elements is governed in part by choice of vegetables in the diet. The role of water in cooking has been examined and results show that while many elements are lost from green beans when cooked in water from north west Ohio, fluorine, lithium, molybdenum and strontium are in fact taken into the vegetable in considerable quantities. The cariostatic effect of the water from north west Ohio used both for cooking and drinking, has been verified experimentally in rat feeding experiments. It is suggested that the explanation for the numbers of caries-resistant recruits from north west Ohio may be in the simultaneous occurrence of elevated concentrations in water of at least boron, lithium, molybdenum and strontium with fluorine."

LOSEE, F. L. and Adkins, B.L. A study of the mineral environment of caries-resistant Navy recruits. Caries Res. 3:23-31 1969.

Detailed report with tables and charts. "Findings, stated briefly, were: 1) Knowledge of oral health was sub-standard. 2) students progressively accumulated knowledge as they pass through grades. 3) the knowledge of oral health was found to be on a level with the reported practice of oral health only in a small number of specific instances such as linkage between regular dental visits and high knowledge of oral health, although eleventh graders who reportedly ate sweets for snacks made high scores on their knowledge of oral health. 4) It is possible for a far greater number of students to achieve a high level of knowledge of oral health and its practice."

LOVE, William C. An assessment of the knowledge and the practice of oral health by selected school children in Kalamazoo, Mich. J. Public Health Dentistry 28:153-166 Summer Issue, 1968.

**SUMMARY:** "An investigation was made of the concentrations of particular elements in public water supplies in relation to the prevalence of dental caries amongst children aged 12 to 14 years who were residents in 19 towns in the eastern United States. This evaluation was based on eleven elements for which quantitated concentrations could be determined. It was found that there were statistically significant correlations between caries prevalence and the concentrations in the water supplies of copper and lead, an increase in caries prevalence being associated with higher levels of these elements in the waters. Results showed some trend to suggest that the detrimental effects of copper and lead could be counteracted by increases in the concentrations of strontium, barium, boron and aluminium, but these findings were inconclusive. The results are considered in relation to what is known of the general metabolic and dental effects of these elements."

LUDWIG, T.G., Adkins, B.L. and Losee, F.L. Relationship of concentrations of eleven elements in public water supplies to caries prevalence in American schoolchildren. Australian D.J. 15:126-132 Apr. 1970.

"One hundred sixty-five cases practising finger, twig and brush cleaning habits have been examined for gingival recession measured from cemento-enamel junction to the base of the pocket. Gingival recession shows maximum values in the finger cleaning group and least in the tooth brush cleaning group at all age levels and in relation to all the teeth examined. Gingival recession increases with advancing age in relation to all the three cleaning habits. Gingival recession decreases in the following order: Lower central incisors; upper first molar; lower first molar and upper central incisors."

MATHUR, R.M.; Chawla, T.N.; Kapoor, K.K. and Mathur, M.N. A study of gingival recession as related to oral cleaning habits. J. Indian D. Assn. 41:159 June 1969.

**Summary:** "Oral hygiene, gingivitis, calculus and the numbers of decayed, missing and filled teeth in a random sample of 2,905 Dundee thirteen year old children were assessed during 1960-1962 and correlated with tooth-brushing and sweet eating habits. 1) One-third of the children stated they brushed their teeth twice or more each day while one-third brushed less often than once a day (Table III). 2) Girls brushed more often than boys and had significantly cleaner mouths. (Tables III and IV). 3) Children who brushed most frequently had cleaner mouths than those who brushed less often (Table V). 4) There was a significant correlation between oral hygiene and gingivitis in both boys and girls (Table VII). 5) Over 99 percent

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of the children had gingivitis somewhere in their mouths (Table VI). It was more marked in boys. 6) There was calculus on two or more teeth in twenty-five percent of children (Table VII). 7) There was subgingival calculus on two or more teeth in 13 percent of the children. 8) Average stated sweet consumption was 17 1/2 ounces a week per child (XI). 9) A high mean number of 10.02 DMF teeth per child was found (XIII). 10) A significant correlation between stated "sweet" consumption and the numbers of decayed teeth was found, but the correlation between stated sweet consumption and DMF teeth was not so significant (XV). 11) There was no significant correlation between oral hygiene and numbers of DMF teeth (XVI)."

McHUGH, W.D., McEwen, J.D. and Hitchin, A.D. Dental disease and related factors in 13-year old children in Dundee. Brit. D.J. 117:246 Sept. 1964.

"A study dealing with the examination of 295 college students and 619 factory workers between the age group of 15 to 20 and 15 to 35 have shown the incidence of dental caries to be 43.98 percent and it was more for factory workers (46.20%) than the college students (39.32%). The DMF percentage and DMF teeth per individual were 4.2 and 1.16 respectively for the groups studied. Lower teeth seem to be more susceptible to caries than upper teeth and caries was noticed to be more on the posterior teeth than anterior teeth. Lower first and second molars were the more commonly affected teeth. Caries was seen to be more on the occlusal surface than any other surface. Although the demand for restorative dentistry existed, attention received was quite negligible. Only 4.4 percent of college students and 1.61 percent of factory workers received dental treatment."

MIGLANI, D.C., Sujeer, V.N., Ross, Chandra, Raghupathy, E. Dental caries and its relationship to saliva and diet. I. Prevalence of dental caries. J. Indian Dental Assn. 42:219-224 Sept. 1970.

"The purpose of this survey is to provide statistical picture of the flow of patients into dental offices and the dental services received by them, on a nation-wide scale. Questionnaires were sent to every sixth dentist in the United States. The number of usable returns was 2,953, providing data on 35,793 patients.....Highly significant changes have been occurring in dental health care during the past two decades. In the 60's, particularly, according to data from this survey, the emphasis has shifted from reparative care to preventive care, and the dental health of dental patients has shown definite improvement. More patients receive preventive care such as prophylaxes, radiographic examinations, orthodontic and root canal treatments; fewer patients receive reparative treatment such as fillings, extractions, and dentures. The fact that there were more patients in age groups 10 to 14, 15 to 19, and 5 to 9 indicates that children's dental health is a prime concern of parents and profession alike. If the trends shown in this survey continue, and there is every reason to expect an even more vigorous swing to preventive care - the 70's will be decisive years for dental health care in this country and for

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the realization of the prime goal of dental research, effective prevention of dental disease."

MOEN, B. Duane and Poetsch, W.E. More preventive care, less tooth repair. JADA 81:25-36 July 1970.

"An epidemiological survey on the prevalence of dental caries and dental fluorosis was performed in four districts in Uganda. 1,394 persons in 13 areas with fluoride concentrations in the drinking water varying from 0.11 to 3.00 ppm were examined. The prevalence of dental caries in the four districts showed the expected inverse relationship with the fluoride content of the drinking water. In the various groups the average DMFT per person ranged from 0.3 to 8.9. The community index of dental fluorosis (Fci) varied from 0.04 in low-fluoride areas to 1.74 in high fluoride areas. The severity of dental fluorosis was found to be higher among Africans than among Asians and higher in males than in females. On the basis of the severity of dental fluorosis and the average mean maximum temperature the optimum fluoride concentration in the drinking water in Uganda is considered to be approximately 0.6 ppm F."

MOLLER, I.J., Pindborg, J. and Peterson, B. Roed. The prevalence of dental caries and dental fluorosis in Uganda. Caries Research 3:222, 1969 (Abstract)

SUMMARY: "A preliminary study of the oral health of 1,181 children in Malta and Gozo was carried out. The df and DMF rates in these children were relatively lower than in children in England. The df rates in Gozitan children appear to be lower than in Malta. Fluoride water levels in Gozo are also higher. The incidence of inflammatory conditions of the gingivae is high and commences at an early age. It is accompanied by low standards of oral hygiene and a high incidence of calculus formation. The most common extrinsic stains were green and brown. Dark superficial stains were found to be associated with lower caries levels, and higher standards of oral hygiene when compared with coloured stains."

OLIVIERI, Munroe C. A study of the oral health of Maltese school children. Brit. D.J. 124:177-182 Feb. 20, 1968.

"Six epidemiologic surveys on periodontal disease in India, Ceylon, Nigeria, Iran and Sudan showed that almost 100 percent of the population in these developing countries had periodontal lesions. A strong positive correlation existed between the amount of debris and calculus and the severity of periodontal diseases. When persons of equal oral hygiene and status were compared, no consistent relationship could be found between periodontal status and sex, race, ethnic background or nutritional conditions."

RUMFJORD, S.P., Emslie, R.D., Green, J.C., Held, A.J. and Waerhaug, J. Epidemiological studies of periodontal diseases. Periodont Acad Rev. 2:109-122 Oct. 1968. (Abstracted in Advances In periodontics 1:14, 1971)



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"A survey was implemented on 1,000 Adelaide children in grade four to seven, representing children of mean ages nine, ten, eleven, and twelve years respectively. Results indicate that children are practising dental behaviour which is far from ideal. Although they are generally aware of recommended dental practices, findings reveal a lack of confidence in the benefits of these activities. Moreover, over half of the children under-rated the limitations of dentures, considering them as attractive and functional as natural teeth."

RODER, D.M. A study of dental knowledge and behaviour in 1,000 Australian schoolchildren. Aust. D.J. 14:327 Oct. 1969.

"The dental state of these 34 inhabitants of the Kuria Muria Islands was of a high standard. The DMF caries rating of 1.19 per head compares very closely with the DMF of 1.10 found in the 183 inhabitants of Tristan da Cunha during the middle thirties (Barnes & Moore, 1937). Apparently the sandy fibrous nature of the dried fish diet has been favorable both to the gingival health and a low rate of caries incidence. Their large uncrowded dental arches may have been a contributing factor. Alternatively, they may have been the result rather than the cause of comparative freedom from caries.....On Hallaniya Island the sandy nature of the diet, leading to marked attrition, may have reduced the liability of caries by eradicating occlusal fissures. On the other hand this does not explain resistance to caries in the children, or in the anterior teeth of both young and old. Furthermore, despite the cleansing action of the sandy, fibrous diet, the mouths were only moderately clean in terms of retained food debris, and this suggests that the absence of fermentable carbohydrates may be the most important single factor involved in the abnormally high standard of general dental health."

RUGG-GUNN, A.J. Caries resistance in the Kuria Muria Islands. Report of a dental health survey. Pakistan Dental Review XX:91-95 July 1969.

SUMMARY: "Examiners from research group (NIH) have surveyed more than 21,000 persons in Alaska, Ethiopia, Ecuador, South Viet Nam, Chili, Colombia, Thailand and Lebanon. Principal preliminary findings: 1) The prevalence of dental caries was very low in some populations with grave nutritional deficiencies. 2) Dental caries was inhibited whenever fluoride ingestion was optimal or mildly excessive. In some areas optimal fluoride effects seemed associated with domestic waters carrying less than 1.0 ppm Fluoride. 3) Most of the variance in periodontal disease scores was associated with faulty oral hygiene and age. 4) Populations with high scores for periodontal disease tended to be deficient in Vitamin A. No association between periodontal disease and ascorbic acid could be demonstrated."

RUSSELL, A. L. International nutrition surveys: a summary of preliminary dental findings. J.D. Res. 42:233-244, 1963.

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"Dental epidemiological studies were conducted on 756 Surrey school children and 1,624 adults living in London and Warrington.....On the basis of the findings reported, it was concluded that dental cleanliness (plaque and calculus) was positively related to the severity of periodontal disease. 1) There were increases in the severity of periodontal disease with increasing levels of plaque and calculus which indicated that persons with poor dental cleanliness had more severe periodontal disease. 2) The severity of periodontal disease was greater in older persons than young persons who had an equivalent level of dental cleanliness indicating that the duration of the irritation from plaque and calculus was related to the severity of periodontal disease. 3) The majority of persons examined had poor dental cleanliness; if these levels of cleanliness persisted the majority of persons aged 15 to 19 years would be in the terminal stages of periodontal disease before the age of 50. 4) reported frequency of toothbrushing was related to the level of dental cleanliness and the severity of periodontal disease; persons who claimed to brush more frequently had cleaner teeth and less severe periodontal disease than persons claiming to brush less frequently. 5) females and persons in the upper social classes claimed to brush more frequently than males and persons in lower classes. 6) As toothbrushing is the most effective method known for improving dental cleanliness, there is need to investigate: Methods of motivating public to brush; the most efficient method of brushing; the most effective brush design."

SHEIHAM, A. Dental cleanliness and chronic periodontal disease. Studies on populations in Britain. Brit. D.J. 129:413-418, Nov. 3, 1970.

Random sample of adults chosen from two towns using the electoral register. The individuals were questioned in their homes by trained interviewers, subjects were given dental examinations: ..... 1/3 had no teeth of their own; 3/4 had untreated dental decay; 3/4 had periodontal disease and only four percent had a natural functioning dentition and needed no treatment. Attitude and treatment pattern varied greater with social status; two people in every three had some form of denture and 90 percent considered that they were free from dental disease. Response rate was 85 percent.

SLACK, G.L., Bulman, J.S., Richards, N.D., Willcocks, A.J. Dental health and the man in the street. Brit. D.J. 123:547, Dec. 5, 1967.

Seventy-five male University students were questioned in an endeavor to find out what they considered to be the greatest cause of tooth loss, their concern to keep their own teeth, and their attitude towards the signs of periodontal disease. The majority (84%) were keen to keep their own teeth, but on examination, only 20 percent were credited with good oral hygiene, though 56 percent had acceptable cleanliness. Half the group were not, or would not be, bothered by an unpleasant taste in their mouths, but as few as 27 percent professed a lack of concern about periodontal pain. Clinically 18 percent of this group, whose ages ranged from 17

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to 25 years, had reddened gingiva and in some cases a severe degree of inflammation.....Tooth decay was considered to be the greatest cause of tooth loss and lack of care the second. Only one student considered gum disease was the greatest cause of tooth loss, but five others coupled gum disease with other features."

SMITH, R. G. Periodontal survey on a group of male university students. Leeds Dent. J. 4:12-19, 1965.

"A dental epidemiological survey was carried out on one-third of the 14 year old school children in the Burgh of Paisley. An assessment of dental caries, oral hygiene, calculus, periodontal disease and treatment needs revealed a high incidence of dental disease. Only 0.6 percent of the 515 pupils studied required no treatment of any sort. Extractions were found to be necessary in 35.3 percent, although 89 percent stated they had a regular dental practitioner. Further data relating to their dental habits showed that 85.8 percent ate between-meal snacks, 98.8 percent owned a toothbrush and over 25 percent spent more than five shillings per week on sweets. Compared to other recently published United Kingdom data, these children had a mean DMF score of 13.04; the highest reported to date."

STEPHEN, K.W. and Sutherland, D.A. A dental health study of 14 year old school children in Paisley. Brit. D.J. 130:19-24 Jan. 5, 1971.

"Two age groups were surveyed to study the health of periodontal tissues and observe changes that occur over a two to three year period. Group A Composed of 130 boys and seven girls aged five to 19 years provided tissue changes during transitional stages from deciduous to adult dentitions. Group B was composed of dental and law students aged 18 to 27 years. These subjects were examined several times during the survey and given oral hygiene instruction each time.....Results showed poor oral hygiene in both groups resulting in gingivitis in most of the subjects. The older group B subjects had more complicating local factors such as poor restorations. Childhood gingivitis isn't always temporary and its incidence increased with age. Young patients require dental treatment to prevent later tilting of posterior teeth which can form potential infra-bony pockets. Lastly, increasing dental knowledge didn't increase personal oral care for the senior dental students surveyed."

STONER, J.E. and Prophet, A.S. Early periodontal disease in children and young adults. Periodont. Abstract XVIII, p. 62, June 1970.

"Fifteen children were evaluated for oral health, dental attitude and physiological responsiveness during dental treatment. Five measures of oral health were used: the Oral Hygiene Index (OHI), number of teeth decayed, and surfaces, number of restored teeth and surfaces. Significant correlations between oral hygiene, number of decayed surfaces and appraisal of dentist was found. High scores on OHI tended ( $p < 0.05$ ) to have a large

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number of decayed surfaces and a negative appraisal of their dentist. This suggests the importance of dental attitude to Oral Hygiene..... This is significant ( $p < 0.1$ ) relationship between ones belief in causality of dental problems and the usefulness of preventive dental procedures. Persons believing in natural causation also believed prevention was possible."

STRICKEN, G. Interrelationships of oral health, dental attitudes and physiological measures. IADR Abstracts, 1968.

"Four hundred institutionalized males between 15 and 34 years of age were examined for gingival inflammation, oral hygiene status and periodontal pocket depth. The quality of mesial contacts of selected teeth was assessed and a recording was made of gingiva-contacting restorations. Brushing frequency on the day preceding examination was determined by interview.....Subjects who reported brushing twice or more on the day preceding examinations showed lower mean gingivitis, debris and calculus scores than those who brushed once or not at all, but no relation between reported brushing frequency and mean pocket depth was apparent....."

SUOMI, John D. Periodontal disease and oral hygiene in an institutionalized population: report of an epidemiological study. J. Periodontology-Periodontics 40:5-10 Jan. 1969.

"This study showed that the presence of calculus and partially calcified dental plaque was associated with a reduction of dental caries of the buccal and lingual surfaces of the mandibular and maxillary first permanent molars in young Guatemalan school children. Calcified plaques in these areas probably arose from high calcium-containing food deposits. (164 subjects)"

SUTFIN, Lloyd V., Sweeney, Edward A. and Ascoli, Werner. Calcifying dental plaque and reduced dental caries in permanent molars of children from two Guatemalan villages. J.D.Res. 49:772-775 July, Aug., 1970.

"Three hundred fifty-nine children of immigrant parents were dentally examined and 288 families visited in their homes to fill in a dental questionnaire. Negro children appeared to show less caries (girls significant at 0.05 level) than white children from the same schools. They also showed significantly better brushing habits. Chinese children appeared to show more caries than white and their brushing habits were significantly worse....."

VARLEY, T.F. and Goose, D.H. Dental caries in children of immigrants in Liverpool. Brit. D.J. 130:27-29 Jan. 5, 1971.

"Two hundred Iraqi children and 222 British children between ages of 13 and 15 living in Baghdad and Greater London in homes with modern

sanitary and service facilities attending schools preparing candidates for higher education were examined. It was found caries incidence in British children much greater and the involvement more extensive than in Iraqi children. The opposite was presented by gingivitis, which was present in 97 percent of Iraqi mouths and 82.4 percent of the British. Calculus was present in 80 percent of the Iraqi children compared with 31.1 percent of British. A good state of oral cleanliness was found in only 14.5 percent of the Iraqi but in 42.8 percent of the British, and the state of oral cleanliness was rated as poor in 23.0 percent of the Iraqi but only 4.1 percent of the British children. Correlations were made between the severity of the gingivitis and the other features. The strongest relations were with calculus, cleanliness and brushing. There was an extremely strong correlation between the brushing frequency and the state of oral cleanliness, the magnitude of the difference between the percentage of those brushing less than once per day and those brushing regularly, even if only once per day, were particularly striking. Similarly, brushing even once per day significantly reduced the deposits of calculus both supragingivally and subgingivally."

WADE, A.B. An epidemiological study of periodontal disease in British and Iraqi children, Rap. et Comm., ARPA, 19-25, 1966. (Note: the abstract from Periodontal Abstracts, J. Western Soc. of Periodontology 15:26, 1967)

"Standards of dental care in United States compared with New Zealand: In New Zealand 93 percent of school children received regular dental care. Average of 72 percent of all carious teeth have been filled. In the United States 50 percent have never seen a dentist and only 23 percent of school children have decayed teeth filled. Where is the dental care sub-standard? The only countries in the world who can match the standard of dental care in New Zealand are the Scandinavian countries - Countries which rely on parents seeking and paying for the professional services of a private dentist in order to meet the dental needs of children lag far behind countries which have an organized program of child care based on cooperation between State and professional sources."

WALSH, Sir John. International patterns of oral health care - the example of New Zealand. Harvard Dental Alumni Bulletin, Special Supplement, Nov. 1968.

"The United States Department of Health, Education, and Welfare has released astounding statistics with reference to the prevalence of periodontal disease in America. In this country's civilian, non-institutionalized population of 111 million adults between the ages of 18 and 79 years, the data included the following points: 1) of 90 million adults with at least one natural tooth, three of four persons had periodontal disease, (including gingivitis), and one out of four had destructive periodontal pathosis. 2) of this same group of 111 million people, more than 20 million were totally edentulous-- with 95 percent of the later group being over 34 years old, the age at which periodontal disease reportedly becomes

the primary cause of tooth loss. In addition to these completely edentulous persons, nearly 10 million more had lost all teeth, in either their maxillary or their mandibular arches. These findings can be translated to mean that of every 100 adults, an estimated 18 people were totally edentulous while nine others had teeth in only one jaw. The now-classic Marshall-Day survey, relating to periodontal disease epidemiology, showed that 80 percent of teenagers at ages 13 to 15 showed evidences of gingivitis; throughout all age groups studied (13 to 60 years) the incidence of gingival disease averaged 76 percent)"

WIEBUSCH, F.B. Preventive periodontics: an evaluation. J. Oral Med. 26:63-70 April/June 1971.

Note, following abstracted from ADVANCES IN PERIODONTICS 1:12, 1971.

"Three thousand two hundred sixty-seven men and women 21 to 50 years old were examined - results showed that 70.62 percent suffered from periodontal diseases, the most frequent being the superficial (38.2) and the dystrophic type (27%).....Statistically significant correlation was noted between the high incidence of periodontal diseases and poor oral hygiene."

WODNIECKI, Jozef, Horodyski, Boguslaw, Karczmarczyk, Alicja, Slowik, Tadeusz and Szafraniec, Irena. The periodontal disease distribution in the Krakow district. Czas Stomat 20:431-437 Apr. 1967.

..."In the adult population, however, the facial surface of maxillary incisors, cuspids and bicuspid are most frequently involved. Other areas involved include the palatal surface of maxillary molars. The most important single cause of gingival recession seems to be tooth malposition followed by faulty or excessive toothbrushing.....High frenum attachments and occlusal trauma do not seem to play the important etiologic role in gingival recession that some authors have thought in the past.....From the few studies done on gingival recession, one must conclude that the incidence of gingival recession does increase with age.....The observations of Everett and Baer also indicate that the alveolar bone can move occlusally with eruption of the tooth. Other factors such as the increased incidence of periodontal disease with age and the malposition of teeth would seem to be important factors in the etiology of gingival recession. If the gingiva is maintained in good health throughout life and the teeth are properly positioned in the dental arch, one may see no gingival recession in old age even in the presence of severe attrition. Good gingival health throughout life would seem to be the crucial factor.....It is interesting that Gorman and O'Leary found gingival recession more frequently in patients with good oral hygiene. One concludes, then, that while good oral hygiene is vitally important, dentists should discourage patients from using a hard natural bristle brush on labially displaced teeth."

WOOFER, Charles. The prevalence and etiology of gingival recession. Periodontal Abstracts XVII:45-50 June, 1969.

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A group of toothbrush manufacturers financed a study to determine partly the toothbrushing habits of a population, but mainly to evaluate the condition of brushes in actual use. A four page questionnaire was mailed to 1,000 homemakers and as part of the study, six toothbrushes were also sent with request that the brushes currently used by the family be sent to the ADA. A total of 2,971 brushes were received and 56 percent were judged unsatisfactory for use. Nineteen percent were capable of injuring the gingiva. Interestingly, when compared to a survey in 1948 where 81 percent unusable brushes were found and another report ten years later where 64 percent unusable brushes resulted, it becomes clear the public is becoming more aware of the importance of a good brush in hygiene procedures. Other interesting statistics: 1) Bedtime is still the most popular time for brushing (71% wives, 60% husbands) 2) Regular dental checkups - 50.3 percent wives, 39 percent husbands. 3) Professional oral hygiene instructions received by 20 percent wives, 13 percent husbands. Of those receiving instructions, 52 percent in dental office. 4) Forty-two percent of household have one brush per member. 5) Fifty-three percent of individuals use a brush four to six months, 19 percent ten to twelve months, and five percent more than one year. 6) One in four households have electric brushes, but 82 percent also use a manual brush.

AUTHOR UNKNOWN: Survey of Family toothbrushing practice JADA 72:1489 June 1966.

### III. DENTAL CARIES AND PERIODONTAL DISEASE (prevention - etiology)

"This study attempted to find a correlation between caries incidence and certain trace elements in the water supply. One finding was that copper and manganese are always associated with high caries prevalence." ADKINS, B.L. and Losee, F.L. A study of the covariation of dental caries prevalence and multiple trace element content of water supplies. N.Y.S.D.J. 36:618-622 Dec. 1970.

"Evidence from this study of 400 individuals has supported the view that supra- and subgingival calculus formation is significantly increased by smoking. It has also partly supported the view that gingival inflammation is increased by smoking, although it was not possible to show a statistical significance in the groups of students. There was no evidence that the smoking of tobacco increased the prevalence or extent of bacterial plaque on teeth. It is inconceivable that anyone who persists in smoking, despite the very grave risk of developing lung cancer or coronary heart disease, will be persuaded to give up smoking because it will cause periodontal disease!" ALEXANDER, A.G. The relationship between tobacco smoking, calculus and plaque accumulation and gingivitis. Dental Health (London) 9:6-9, Jan.-Mar. 1970.

"In the group of 200 dental students and staff lack of function of teeth was associated with a significant increase in the prevalence and extent of inflammation in the related gingival tissues, but there were no significant increases in deposits of calculus or stainable bacterial plaque on nonfunctional teeth. In the group of 200 patients lack of function was associated with a significant increase in the prevalence and extent of the inflammation in the related gingival tissues. More subgingival calculus and stainable bacterial plaque formed on nonfunctional teeth, but there was no significant increase in deposits of supragingival calculus, however."

ALEXANDER, A.G. The effect of lack of function of teeth on gingival health, plaque and calculus accumulation. J. Periodont. 41:438-441 Aug. 1970.

Purpose of this review: I. Evaluate different methods of motivation for better oral hygiene....II. Test the effect of toothpastes upon oral hygiene and periodontal health....III. Evaluate some factors concerning clinical trials in periodontal research. 1. Hexachlorophene - fortified toothpaste had no effect on oral hygiene or periodontal health.....2. Enzyme toothpaste had no effect on oral hygiene or gingival health... 3. Audio-visual education improved oral hygiene over a control group.... 4. Examiner error was discussed.



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ANERUD, Age. Effect of preventive measures upon oral hygiene and periodontal health. The Department of Periodontology, Dental Faculty, University of Oslo, Universitetsforlaget, 1970.

This series of papers is the result of a conference entitled "evaluation of agents used in the prevention of oral diseases," held by the New York Academy of Sciences on Jan. 12, 13, 14, 1967..."The direct task here is the critical examination of methods employed in the evaluation of agents used in the prevention of oral disease. Dental caries, periodontal disease, oral calculus and poor oral hygiene have been included as simultaneous topics for two reasons. First, their combined effects account for the major part of the oral health problem of the nation. Second, there is much interplay; between them, and efforts to bring any one under control without regard for possible influences on the others is not realistic....."

Annals of the New York Academy of Sciences: Evaluation of agents used in the prevention of oral diseases. Published by the Academy, Dec. 23, 1968. V. 153, Art. 1, pgs 1-388.

"....The ecologic approach to the problems of oral microbiology does not mean loss of interest in the actual or potential pathogenicity of particular biotas; but it does mean much more. It means to search for a background or a perspective or a frame of reference in which or from which we can form a juster estimate of the significance of a particular biota; and further it alone can guide us to that basic knowledge upon which to build a rational hygiene of the mouth in so far as this hygiene is related to the micro-organisms which, from our birth to our death, struggle for existence in our mouths."

APPLETON, J. L.T. The problems of oral microbiology as problems in ecology, Chicago, Illinois, A.D.A. Proc. D. Centenary Celebration, 1940, p. 282-294.

This paper describes natural history and physical characteristics of the microcosms of the human mouth. Those adherent, colonized, microbial communities found on the teeth, tongue, mucous membranes and tonsils, as well as the dispersed microbial elements within the thin film of saliva, have been described and illustrated, grossly and microscopically.

ARNIM, Sumter. Microcosms of the human mouth. J. Tenn. St. Dental Assn. 39:2 January, 1959.

"Dental caries is a deficiency disease caused by an insufficient supply of tooth nutrients in the daily fare. Tooth nutrients are, in the first place, the minerals that form and catalyze the formation of the tooth structure. Thus the resistance of a tooth against dental decay is es-

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established during formation of tooth and life-long resistance can be maintained by a continuous and proper tooth nutrition. A normal, well nourished tooth is immune against dental caries."

ASLANDER, Alfred. Dental caries - a case of osteoporosis? Pakistan Dental Review XVIII: 6-10 Jan. 1968.

"While severe systemic disease or hormonal imbalance or nutritional deficiency may, at times, cause inflammation of the periodontium, it is the omnipresent microorganisms that constitute a chronic challenge to the oral soft tissues. The chronic nature of periodontal disease suggests the potential of microorganisms of the subgingival plaque as the primary etiological agent."

BAHN, Arthur N. Microbial potential in the etiology of periodontal disease. J. Periodont. 41:603-610 Nov. 1970.

"Using a brush in a highly skillful manner, you can achieve removal of bacteria from about 85% of tooth surface. This is where about 15% of our dental disease originates. The 15% that you consistently miss, is where about 85% of all dental disease occurs."....(Author discusses original research by Bass & Arnim and recommends dentists become exposed to effective method of teaching people to control their disease.)

BARKLEY, Robert F. Toothbrushing - the hoax of American Dentistry. Arizona D. J. 13:14-16 Nov. 15, 1967.

Summary: "The two principal diseases of the teeth, caries and periodontoclasia, can be prevented, practically 100%, by following the right method of PERSONAL ORAL HYGIENE, but NOT WITHOUT IT. Individual personal instruction is necessary. The teeth must be cleaned, at the vulnerable locations with the right kind of toothbrush and dental floss, every night before retiring. Fluoridation of public water supplies to reduce caries is potentially harmful mass-medication. Topical application of fluorides has little or no specific anticaries effect, and is not needed."

BASS, Charles C. Neglect of prevention of dental disease. Pakistan Dental Review 19:57-62 April, 1969. ....also published in J. La. Med. Soc. 120:30-5 Jan. 1968.

"The following facts were identified 20 years ago by two bacteriologists, the Dean of the Tulane Medical School and the Dean of the University of Texas Dental School. They were conducting research independently into the causes of dental diseases. They each made different scientific discoveries concerning the relationship of bacteria to dental diseases, and their findings were correlated: (1) Approximately 96% of all harmful bacteria in the mouth live in the crevices near the gum line between the tooth and gum. (2) The damage done is not related to the number of bacteria

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present, but rather to their state or organization. It was found that bacteria must be organized or clumped together in tiny colonies or clusters before they are capable of producing harmful effects such as decay, tender bleeding gums, foul breath, etc. The presence of bacteria alone in a disorganized or unclumped state, however, produces no harmful effects. (3) Once disorganized, it takes 24 to 30 hours for the bacteria to reorganize. If, once a day, all bacteria in the mouth is completely disorganized, dental disease will not occur. The teeth will be free from decay, there will be no periodontal infection due to bacteria, the mouth will be healthy, and an individual will no doubt keep his teeth for the rest of his life." (Note: Article describes Tucson public schools' dental health program in detail and references include Bass & Arnim) Conclusion: "If all the control measures currently available were disseminated and utilized, dental disease could be eliminated....A program of dental health education and mouth hygiene can and should be part of every school curriculum."

BUGBEE, Ruth S. An effective program in dental health education. J.A. Dental Hygienists' Assn. 45:40-43, 4th Qtr., 1970.

"A new plastic paint to prevent decay on a tooth's grinding surface will be tested under a grant from the National Institute of Dental Research by Dr. Michael Bunocore....with another resin he obtained an 86% reduction in decay after one year even though that material was more difficult to use, requires no drilling, and in preliminary tests has remained adherent for more than one year. It is painted on much like nail polish, but does not harden until an ultra-violet (UV) lamp is shined on it..... This changes the colorless liquid adhesive to a hard, smooth, nearly invisible film."

BUONOCORE, Michael. New plastic decay-preventive to be tested. J. Kansas St. Dental Assn. 54:19 January 1970.

"The caries-reducing effect of a single application of a liquid adhesive to the pits and fissures of human teeth by a simplified technique that involves polymerization of the adhesive by ultraviolet light has been reported. After two years the pits and fissures on surfaces of permanent teeth showed a 99% caries reduction, whereas the surfaces of deciduous teeth showed 87% caries reduction. Complete adhesive coverage after two years was present in 87% of the permanent surfaces and in 50% of the deciduous surfaces. Where loss of adhesive occurred it was complete, with no part of the adhesive remaining bonded to the pit or fissure area. Adhesive sealing could be an important adjunct in caries prevention programs used in clinical practice since it is intended for the caries-susceptible areas that are least benefited by fluoride."

BUONOCORE, Michael G. Caries prevention in pits and fissures sealed with an adhesive resin polymerized by ultraviolet light: a two-year study of a single adhesive application. JADA 82:1090-1093 May 1971.

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(Introduction describes W. D. Miller's theories.)",....This infectious and transmissible agent has been found to be a distinctive type of streptococci. It is commonly called caries-inducing (CI) streptococci and most closely resembles Streptococcus mutans which was probably first isolated from the oral cavity in 1924. They are definitely not enterococci. The etiological relationship of the CI streptococci to dental caries has been reinforced by their being present in large numbers in the dental plaque, in both human beings and animals and by their producing considerable extracellular dextran from sucrose. While the CI streptococci, capable of inducing dental caries in experimental animals, have been isolated from human dental plaque and carious lesions, due to general unavailability of gnotobiotic humans, direct evidence has not been obtained as yet of their caries-inducing potential in human beings. However, the CI streptococci can be implanted in the oral cavity of both humans and animals where they apparently become the predominant resident microorganism in the plaque. An increased amount of sucrose in the diet favors implantation of the CI streptococci. Antibiotics to which they are sensitive (e.g., penicillin, erythromycin) will suppress the CI streptococci in animals who remain free of the CI streptococci in successive generations unless reinoculated in some way with CI streptococci. If, however, one of the generations of animals is infected with CI streptococci, caries develops abundantly and the organism is transmitted to successive generations. The CI streptococci seems to operate in dental caries by producing dextrans from sucrose, a factor essential, if not contributory, to the formation of the plaque. They also function in dental caries, along with other oral acidogenic bacteria, by acting on the simpler carbohydrates to readily produce the acids necessary for decalcification of tooth tissues."

BURNETT, George W. Old and new concepts of dental caries. Texas Dental J. 89:16-20 Jan. 1971.

"Plaque for the purpose of this report, is a mucoid, microbial colonization which is loosely adherent to tooth surfaces which varies in color from white to yellowish gray, and harbors numerous microorganisms capable of producing acid. It contains salivary mucin and their constituents derived from saliva and food residues which have dissolved or diffused into it. Plaque has been implicated as an etiological agent in both dental caries and periodontal disease."

CLARK, Charles A. and Fintz, James B. ..and the children shall lead them. J. Am. Soc. Preventive Dent. 1:26-29 July-Aug. 1971.

"Caries of pits and fissures of molar and bicuspid comprises a high percent of lesions found within two years of eruption in these teeth, and is responsible for considerable tooth loss. The prevention of pit and fissure caries through adhesive sealing, by expanding the benefits due to water fluoridation, has obvious public health advantages. Study was undertaken to 1) evaluate ability of adhesive resin composition to bond to and seal the clinically caries free pits and fissures of molars and

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bicuspid, and 2) to assess the caries preventive potential of this sealing. 300 control and opposite quadrant experimental teeth were employed in a one year test period. The tooth colored adhesive comprising methyl-2cyano acrylate (EK 910) and inorganic fillers was applied to pits and fissures after prophylaxis and conditioning of the enamel surface, allowed to harden from one to two minutes and reduced to occlusion where required. Patients were recalled after six months according to experimental protocol, new adhesive was applied over the remaining original adhesive which in most cases was retained at this time. Preliminary results indicate that adhesive sealing of pits and fissures is effective in caries prevention. In control teeth, 112 had developed clinical caries compared to only ten teeth in experimental group. Caries in the experimental group was generally associated with early loss of adhesive mainly from distal occlusal fissures of upper second molars. Initiation or progression of caries from original condition was not observed under the adhesive. Once bonding is established, it appears to be maintained."

CUETO, E. and Buonocore, M. Adhesive sealing of pits and fissures for caries prevention. IADR Abstracts, 1965.

"The possibility that the high cadmium content of the Manning soil and water could increase caries is in line with the findings in animal experiments and the high levels of caries in cadmium miners. While the small size of our study group (42 subjects) prevents the drawing of firm conclusions, the possibility that lead and cadmium may play a part in the caries story is worth keeping in mind, in view of the increasing contribution of the automobile to environmental contamination with these two elements."

CURZON, Martin E. J. and Bibby, Basil G. Effect of heavy metals on dental caries and tooth eruption. J. Dent. Children XXXVII:463-465 Nov. Dec. 1970.

"Rationale procedures for prevention and control: 1) communal fluoridation and/or use of topically applied fluorides in the form of solutions and lozenges, chewing gums, dentifrices, or gels, to increase tooth resistance. 2) Early, routine periodic dental appointments to condition and educate pre-school children at about 2 1/2 years of age, and of greater importance to educate their parents regarding prevention and control of oral disease. 3) dietary management - institution of well-balanced diets with restriction of between meal fermentable carbohydrates. 4) oral hygiene, i.e. conscientious toothbrushing and dental flossing, preferably just after meals, and 5) better cooperative planning and understanding of caries prevention and control among parents, children, pediatricians, schools, parent-teacher's associations, the health department and other community organizations."

DALE, Peter P. Dental Caries. JAMA 188:1024-1025 June 15, 1964.

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"Cariogenic activity in humans was studied with an intraoral test. Enamel slabs covered with Teflon or Dacron gauze were fixed in prosthetic devices and worn in subject's mouths for periods of one week. Decrease of enamel microhardness in Knoop numbers (-KHN) reflects partial enamel demineralization presumably related to current cariogenic activity. The following investigations were performed on eight subjects in a total of 133 experiments: (a) The covered enamel slab was mounted in either a buccal or an interproximal position. Interproximal mounting was found more cariogenic (average -25 vs. -55 KHN with extremes of -50 to -150 KHN), (b) The gauze was partially wrapped by an impermeable plastic film in order to reduce the local salivary flow. This condition tended to increase cariogenicity (Average - 50 vs. -100 KHN with extremes of -132 to -206 KHN). (c) Orthodontic bands with Edgewise brackets were used as carriers of the test system. In the region of the first maxillary molar, cariogenic activity as reflected in this test was minor (Average -0.2 with extremes of +61 to -64 KHN). This system is being investigated for its response to restriction of salivary flow and to the supply of sucrose. In general, the individual seems to be an outstanding factor. In two cases, very pronounced cariogenicity was concurrent to inflammation of nasopharynx."

DIMITRIADIS, A., Lastra, J., Keller, S. and Koulourides, T. Some conditions affecting experimental cariogenicity in humans. IADR Abstracts, 1969.

Conclusions: (1) Organic acids produced by fermentation of carbohydrate material decalcify all human enamel in vitro. (2) The rate of acid decalcification of human enamel varies. (3) A general acid condition of the oral cavity does not produce true dental caries, but may predispose to caries. (4) Mucin plaques present a favorable environment for acids to accumulate and decalcify enamel. (5) Weak alkaline salts of saliva do not pass through plaques in sufficient amounts to be important in controlling acids that produce caries. (6) Alkaline mouthwashes are of no value in controlling acids that produce caries. (7) Soluble carbohydrates in the mouth diffuse through plaques, and under favorable conditions are changed to acids. (8) Plaques are practically insoluble in all solns that can be tolerated in the oral cavity.

DOBBS, Edward C. Local factors in dental caries. J.D.Res. 12:853-864, 1932.

"Three hundred forty-nine children, age 12-14 years, screened for carious lesions. From this population 21 caries-free and 21 caries-rampant subjects were quantitatively evaluated for dental plaque and weighed dietary and oral hygiene scores.....This study suggests that diet and oral hygiene together with plaque formation are contributing factors to caries development in this age group----

DUANY, L. F., Zinner, D.D., and Jablon, J.M. Plaque, diet, oral hygiene and incidence of cariogenic streptococci in caries-free and caries-rampant children. IADR Abstracts, 1969.

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".....knowledge of bacterial plaque is vital to dental patients in our joint effort to eliminate and eventually PREVENT CARIES & PERIODONTITIS." ..... "Bacterial plaque is a well-organized bacterial "community" made up of a definite and consistent range of bacterial types. It should not be equated with or mistaken for materia alba, stains, calculus, food particles or similar entities which have been discussed in literature over the years....The damage done to the periodontal tissues by the many toxins and enzymes may be either direct destruction of a specific tissue component or indirect as with endotoxin which will act on host polymorphonuclear leucocytes, to cause it to release its own cell destroying enzymes which in turn stimulate the generalized state of inflammation....(control methods to be discussed in later article.....Conclusion: There is no longer any question as to the cause of periodontitis or dental caries. The evidence is overwhelming in both objectivity and sheer volume. Consequently these diseases are entirely preventable."

EBERT, John R. A brief review of bacterial plaque. J. Hawaii Dental Assn. IV:19-21 July 1971.

"whenever a dentist discerns a periodontal disorder during a mouth examination, he tends to look for local etiologic factors. Accretions on teeth and food packing between teeth are often blamed for a gingival inflammation and occlusal interferences may be held responsible for the breakdown of the bone that supports the teeth. It is only within recent years that systemic substrates have been given serious consideration by periodontologists as initiating, contributing, exciting, precipitating, predisposing, or perpetuating factors. The dental practitioner must be guided by the maxim that has always been of paramount importance in clinical medicine--that the totality of the patient who has a health problem is at least as important as the problem that he presents."

ELFENBAUM, Arthur. Clinical Conference: Periodontal disease without local factors. Dental Digest 76:472-474 Nov. 1970.

"Periodontal disease is of infectious origin. It is unlike acute bacterial diseases in that the organisms that cause it do so as an accident. They are bacteria that find the human oral cavity, particularly the regions adjacent to the gingival attachment, a happy environment. They are elective pathogens. If other organisms could survive there they would probably produce the same process.....The question of transmissibility is unanswerable.....I know of no evidence that a process similar to human periodontal disease occurs in the absence of an infectious agent."

ELLISON, Solon A. Oral Bacteria and Periodontal disease. J.D. Res. 49:198-202 Mar.-Apr. 1970.

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"Epidemiologic studies have shown that acute necrotizing ulcerative gingivitis (ANUG) appears in groups of people subjected to such situations of stress as entering the armed forces and college. A personality study was performed during the indoctrination phase of training of 82 Naval aviation students. Of this group 41 had ANUG and 41 had healthy gingiva. The disease was scored and simple linear correlations were performed between ANUG and 15 personality trait scores. Significant correlations ( $p < 0.05$ ) were found between two personality traits (dominance and abasement) and ANUG. The correlations between dominance and ANUG was positive, while the correlation between abasement and ANUG was negative."

FORMICOLA, A. J., Witte, E. and Curran, P. A study of personality traits and acute necrotizing ulcerative gingivitis. Periodontal Abstracts XVIII: 62 (Abst) June 1970.

"Thus it can be seen that prevention of caries at the practice level does not consist merely of applying solutions of fluoride to the teeth. It requires a complete change in attitude and approach on the part of the dentist, the attitude of his patients by parent education, and of his staff which should be organized as a dental team. Basic requirements are these: (1) The dentist and his aides must be themselves convinced and confident of the efficacy of a preventive programme. Assistants and patients will be influenced by the dentist's enthusiasm. (2) The "prophylactic odontotomy" approach should be largely abandoned. Fillings and more fillings to prevent fillings does not make sense. There is evidence that the more fillings which patients receive, the more they require. A mouth in which the teeth are peppered with unsightly amalgam fillings on all surfaces has not had the best treatment, although many dentists surprisingly consider that they are practicing true prevention. (3) The dentists should rethink what constitutes a "cavity". Is initial caries attack a "cavity?". The tendency is to consider that all breaches of surface should be filled. Thus the state dental service actually encourages the filling of sticky pits and fissures,.....In a real preventive programme sticky fissures should not be subjected to cavity preparation and filling, but the effect of topical fluoride over a period should be noted. (4)...The rampant caries mouth is a special situation mouth and Massler (1967) has postulated control of the infection before embarking on extensive restorations. (5) The dentist must be careful not to be the causation of dental disease or recurrent disease, "such as inadequate preparation leading to further breakdown of weak enamel walls, poor restorations, filling overhangs, over-enthusiastic polishing of teeth with brushes and pumice that scratch the surface and favour plaque attachment, overenthusiastic polishing of fillings which may overheat amalgam and affects its physical properties and also the use of abrasives may tend to lessen resistance to caries attack by removing the protective layer of enamel containing the most fluoride ion"...

FORREST, J. L. Prevention of caries in child patient. Dental Practice Vol. 2, Nov. 2, 1971, pp. 1-3.



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"In order to determine what relationship exists between oral hygiene (OHI - Greene and Vermillion), dental caries (DMFT - Klein and Palmer) and periodontal disease (PI-Russell) based on longitudinal data, annual examinations performed on 289 high school students.....While oral hygiene was associated with periodontal disease during each examination period, there was no demonstrable relationship between the change that occurred naturally in the variables during a two year interval, suggesting that the progression of the diseases occurs independently of each other."

FRIEDMAN, L. A. and Ship, I.I. The incidence of periodontal disease in adolescents as related to oral hygiene and dental caries. IADR Abstracts, 1968.

SUMMARY: "An investigation of the association between supragingival plaque, subgingival plaque and gingival crevice depth was conducted. The 35 subjects were groups depending on the type of surgery performed: the embellished periodontal flap, the unembellished periodontal flap and extraction. All subjects were scored for supragingival plaque and gingival crevice depth before surgery and for subgingival plaque either during surgery or immediately afterward. The statistical analyses used disclosed no significant difference between supragingival and subgingival plaque scores. On the basis of the extracted teeth studied, a positive correlation was found between both supragingival and subgingival plaque and crevice depth."

FUNDAL, Carol P. and Ash, Major M. Pilot investigation of correlations between supragingival plaque, subgingival plaque and gingival crevice depth. J. Periodontology-Periodontics 40:636-638 Nov. 1969.

"Preventive dentistry cannot be achieved without motivation. The psychology of motivation for preventive dentistry encompasses the following factors: 1) Fear and punishment as a means of motivation. 2) Appeal to or instill understanding. 3) Pride in health and appearance. 4) Be challenged, ie., how well do you accomplish objectives. 5) Recognition as a means of motivation, and 6) Being extremely personal as a means of motivation."

GARDNER Alvin F. and Rothman, Martin A. Oral Medicine Seminar No. 18 - Preventive dentistry and the behavioral sciences. J. Conn. S. D. Assn. 43:114 April, 1969.

Summary: "A vast body of information has indicated bacterial plaque as the responsible initiating factor in dental caries and inflammatory periodontal disease. The magnitude of the problem of treating and repairing the ravages of these two diseases is too great for our existing dental manpower to handle for our total population. Plaque control as a preventive and posttreatment maintenance regimen has been outlined in this paper. The chief ingredients are: 1) a thorough and precise teaching program utilizing both dentist and auxiliary personnel; 2) use of dis-

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closing solution to delineate problem areas; 3) use of soft nylon tooth brush, dental floss to remove plaque, particular attention being paid to interproximal and cervical areas."

GOLD, Steven I. Three keys to plaque control - motivation, visualization and regular cleansing. NY St. D.J. 37:281-284, May, 1971.

Article discusses clinical research that focuses on the role of oral hygiene in periodontal disease and control and concludes with: "But we believe strongly that periodontal disease, in the great majority of individuals, is preventable and controllable (at least in its early stages) by proper personal hygiene practices together with adequate professional assistance.....Today, enthusiastic action is still lacking, yet there can be no doubt that the relationship between periodontal disease and oral hygiene has been demonstrated beyond question."

GREENE, John C. and Vermillion, Jack R. Oral hygiene research and implications for periodontal care. J.D. Res. 50:184-193 Mar.-Apr. 1971.

"Color changes in methyl red solution (0.1%) after application of glucose to the teeth, has proved to be a reasonably reliable method of predicting caries activity as determined by susceptibility tests on 250 patients followed by clinical caries examinations a year later. Refinements in technique appear to give more accurate results - these include: 1) ignoring areas of orange-red color development and scoring only areas which turn true red. 2) scraping away heavy surface films in fissures to allow penetration of dye to the tooth surface. 3) spraying the teeth with glucose solution in addition to using it as a rinse. The findings lend weight to the acidogenic caries theory as an important (but not necessarily exclusive) factors in caries development."

HARDWICK, J. L. A clinical assessment of the accuracy of the methyl red test in forecasting caries. Brit. Dent. J. 108:255-259, April 5, 1960.

(81 children, age 7-16, 15 year study.)....."More tooth regions are attacked for the first time at 12 years of age among boys and 13 years of age for girls. Incidence of carious lesions is greater in posterior teeth than in anterior teeth, and more so in girls. The first proximal surface attacked is the mesial of upper first molars in girls at seven years, and the mesial of lower first molars in boys at age nine. Lower incisor and canine teeth of both boys and girls are relatively immune."

HARRIS, Robert The biology of the children of Hopewood House, Bowral, N.S.W. VI the pattern of dental caries experience. Aust. D.J. 12:220-227 June, 1967.

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SUMMARY: "This study (188 male and female Caucasian subjects, aged 18-60) shows that the formal level of education correlates inversely as a strong coefficient with the severity of periodontal disease, but does not inversely correlate as reliably when applied to indices of oral hygiene in a diverse group. Since severity of periodontal disease is believed to be a measure of neglected oral health, and degrees of oral hygiene are a measure of oral cleanliness, other socioeconomic factors of social status may influence the correlation. Although an increase in toothbrushing frequency is associated with less severe values of debris, oral hygiene, calculus and periodontal disease, statistical significance did not show a large reduction of periodontal disease manifestations with increased toothbrushing frequency with an educational value as the socioeconomic factor resulted. No relationships were established with age."

HORTON, John E., Zimmermann, Eugene R. and Collings, C. Kenneth. The effect of toothbrushing frequency on periodontal disease measurements. J. Periodontology-Periodontics 40:14-15 Jan. 1969.

As a result of the marked improvement in the oral health of children of Bloomington during the past 18 years, their dental caries prevalence (312 children) was compared to children of a similar age who were either permanent residents of a fluoridated city (193 children-Fort Wayne) or of a community where no dental health education has been offered (426 children, Nashville). The data indicated a similar prevalence for the Bloomington children and for those who were residents of the fluoridated city, both of which, however, had approximately 50 percent less dental caries than the community having no previous experience with dental health education.

ISAACS, Roger and Muhler, Joseph C. Comparison of dental caries prevalence in three cities. J. Dent. Child. 36:181-185 May-June, 1969.

Indian dental students had higher scores than the Norwegian dental students. The differences in scores of both Periodontal Index and Simplified Oral Hygiene Index was statistically highly significant. No statistically significant differences were found between the scores for betel leaf chewers versus nonbetel leaf chewers. No statistically significant differences were found in the Periodontal Index of smokers versus nonsmokers, either in India or in Oslo. Smokers in Oslo had a statistically significant higher Debris Index score than the nonsmokers. There was no statistically significant difference in any of the applied scoring systems between females and males, either in India or in Norway. When students with equivalent Debris Index scores were compared, no statistically significant difference was found between the Indian and Norwegian groups in the Periodontal Index scores.

JOHANSEN, Jan R. A survey of the periodontal conditions of dental students in India and Norway. Acta Odont. Scand. 28:93-116 Mar. 1970.

"The early elimination of enamel fissures was recommended by Hyatt who recognized the danger of incipient dental caries in the base of the fissures. Dr. Hyatt intended that these surfaces should be restored later. For a decade this procedure was opposed by a great number of dentists on the grounds that to restore areas where the carious process had not begun was irrational. Microscopic examination later demonstrated the presence of caries in the base of enamel fissures in apparently sound teeth. Purpose of this study is to investigate the prevention of, the increased resistance to, and a reduction in the extent of elimination of pits and fissures of newly erupted permanent molars, by topical applications of solutions of 5 percent acetic acid and of 5 percent chromic anhydride to the newly ground surfaces of teeth so operated.... The findings showed a 65 percent reduction in caries incidence in relation to the "tooth" unit and 72.3 percent in relation to the "surface".

JUNIOR, Oswaldo Walder and Moreira, Ben-Hur Wey. Effectiveness of acetic acid and chromic anhydride in prevention of dental caries. J. Dent. Child. 38:134-136 Mar.-Apr. 1971.

Conclusion: "In the past few years, encouraging progress has been made toward elucidating the dietobacterial factors that lead to dental caries. Although further characterization of dentobacterial plaques is needed, the evidence is convincing that certain types of zooglycic deposits are conducive to carious lesions or periodontal lesions or both. Treatments of dental caries that do not include control of microbial deposits represent the abatement of symptoms rather than the control of disease, namely, bacterial plaque infections. If modern dentistry is to make significant progress toward preventing the progressive loss of teeth and dental tissue that presently occurs, it must develop more effective therapeutic programs to control the formation of odontopathic plaques or to keep such deposits below the level at which toxic reactions occur."

KEYES, Paul H. Research in dental caries. JADA 76:1357-1373 Jan.-June, 1968.

"The need for good oral hygiene, that is, the adequate removal of food residues, "debris", and "Materia alba", has been recognized and advocated.(27-30). It now appears that even better results can be attained by advancing the more meaningful approach that the therapeutic goal is to prevent bacterial colonization of teeth and control bacterial plaque infections. To achieve this goal, the mechanical dispersion of bacterial deposits often needs to be supplemented with agents that suppress pathogenic microorganisms.

KEYES, Paul H. Present and future measures for dental caries control. JADA 79:1395-1404 Dec. 1969.

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"If it is possible to identify specific pathogens or key plaque-forming bacteria, the diagnosis and treatment of infections causing the most prevalent periodontal pathoses might be improved. Conceivably, target drugs and specific therapeutic measures might be developed. If, on the other hand, key microorganisms and essential factors are not involved, then various "shotgun" programs will probably offer the principal means for control of cervicoradicular plaque infections."

KEYES, Paul H. Are periodontal pathoses caused by bacterial infections on cervicoradicular surfaces of teeth? J.D.Res. 49:223-228 Mar.-Apr. 1970.

Conclusions: "In summary, by altering availability of saliva and retention of carbohydrate, dentition morphology would affect the entry and exit functions of the plaque system, the availability of regulators of plaque metabolism and, as a result, both the microbial flora and the formation and accumulation of acid by the dental plaque."

KLEINBERG, I. Formation and accumulation of acid on the tooth surface. J.D.Res. 49:1300-1316 Nov.-Dec. 1970.

Conclusion: "Comparatively little is known about the bacterial and chemical composition of plaques of different age groups. One clear difference between adolescents and adults is in their calcium and phosphorus levels. The lower levels of these elements in adolescent plaques is reflected in their lower tendency to form calculus, but what effect they have on plaque formation and the types of plaques formed at the present time is only suggestive and awaits future investigation."

KLEINBERG, I., Chatterjee, R., Kaminsky, F.S., Cross, H. G., Goldenberg, D. J. and Kaufman, H. W. Plaque formation and the effect of age. J. Periodont. 42:497-507 Aug. 1971.

".....oral hygiene is a highly effective preventive method for bringing about a 90 percent reduction in the incidence of periodontal disease. Emphasis must be placed on the efficiency of cleansing and on success in removing and preventing the accumulations of accretions and debris on the teeth and gingivae rather than on the frequency of toothbrushing. Home cleansing must be supplemented by dental prophylaxis at six month intervals, or more frequently, if necessary, and by checking the efficiency of home cleansing procedures. If we can promote widespread application of oral hygiene for the prevention of periodontal disease and proper uses of fluorides for the prevention of dental caries, and then couple or supplement these with the treatment procedures now available to us, we can with confidence conclude that we have a program which is truly designed to insure lifetime teeth."

KNUTSON, John W. Recent developments in the prevention and treatment of periodontal disease. S. Calif. St. Dent.Assn. J. 32:140-145 April, 1964.

"The effect of prolonged supervision of tooth brushing on gingival health and oral hygiene was studied in 78 children, 11-12 years old; experimental group, 38 subjects, brushed their teeth daily for more than two years under direct supervision of a trained dental nurse. Loe & Silness Gingival Index (GI) and modified Greene and Vermillion Plaque Index (PII) was used. Examination revealed: A mean (GI) score of 2.34 in experimental group and 9.15 in control group - a difference ( $p < 0.001$ ). A mean (PII) score of 18.24 and 20.33 respectively, a difference of ( $p > 0.05$ ). A qualitative difference between the plaque and that supervised toothbrushing is an important factor in the prevention of gingival inflammation in childhood."

KOCH, Göran, and Lindhe, Jan. The effect of supervised oral hygiene on the gingiva of children. Odont. Rev. 16:327-335, 1965.

"A clinical examination with mouth mirror, explorer and bite wing radiographs was performed to determine the prevalence of secondary caries in 1,134 Navy recruits. This data was used to make a surface-by-surface comparison of secondary caries indices with susceptibility indices. In the study 10,548 restored tooth surfaces were examined. It was possible to make interesting comparisons of the relative ability of silicate and resin restorations to resist secondary caries. The overall average for amalgam failure was the highest of the materials evaluated. However, resin experienced nearly the same rate of failure in an area of the dentition far less susceptible to caries."

LASWELL, Harold R. A prevalence study of secondary caries occurring in a young adult male population. IADR Abstracts, 1967.

"Serum haemagglutinating antibodies to nine strains of streptococci and two of lactobacilli were determined in 47 subjects. These were divided into a group with a high DMF index (mean 16) and another with a low DMF (mean 3). Haemagglutinating antibodies were detected to all bacteria tested and in most sera from subjects with a high and low caries experience. Antibody levels to Streptococci FA-1 and K1R, cariogenic to animals, and an oral strain of Lactobacillus acidophilus were significantly raised in subjects with a high DMF as compared with those having a low DMF index. The cumulative antibody titre to 7 streptococci, cariogenic to animals, was significantly raised in subjects with a high caries incidence. These immunological results are consistent with the established view of a bacterial pathogenesis of dental caries in man."

LEHNER, T., Wilton, J.M.A., and Ward, R.G. Serum antibodies in dental caries in man. Archs oral Biol. 15:481-490, June 1970.

Conclusions: "At present no clinical methods are available for rendering the tooth surface unfavorable for plaque formation. Owing to the anatomy of the dentition, a hard diet requiring prolonged chewing can reduce plaque formation and gingivitis in dogs. Chewing of fibrous

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food (carrots) between meals cannot prevent plaque formation or gingivitis in man. Sucrose in the diet accelerates the production of extracellular polysaccharides, with extensive plaque formation promoting caries and periodontal disease. However, it is very doubtful whether people consider such a risk sufficient to motivate restriction of sugar consumption. Experiments with antiseptics incorporated in mouthwashes have shown that it is possible to suppress the oral microflora to such an extent as to prevent plaque formation and thereby chronic gingivitis. So far, however, this prophylactic principle has not been tried in a large group of individuals. Furthermore, the preparations as yet have not been evaluated thoroughly for side-effects. The principle is promising, but such a mouthwash is not commercially available at this time. Thus, toothbrushing and other mechanical cleansing procedures seem to be THE ONLY EFFECTIVE, PRACTICAL MEASURES available for the prevention and control of dental plaque and thereby of periodontal disease."

LINDHE, Jan, Lundren, D. and Nyman, S. Considerations on prevention of periodontal disease. (Literature Review) Periodont. Abst. XVIII: 50-57 June 1970.

Summary: "Withdrawal of all measures of oral hygiene in twelve healthy persons with clinically normal gingivae resulted in gross accumulations of soft debris and the development of marginal gingivitis in all subjects. The time necessary to develop gingivitis varied from ten to 21 days. Concurrent bacteriological examinations showed that the number of microorganisms in the gingival area increased and that distinct changes in the relative composition of the flora occurred. Reinstitution of oral hygiene resulted in healthy gingival conditions and reestablishment of the original bacterial flora."

LOE, Harald, Theilade, Else and Jensen, S. Borghlum. Experimental gingivitis in man. J. Periodontology 36: 177-187, 1965.

"On the basis of our present state of knowledge of the etiology and pathogenesis of marginal periodontal disease, it becomes increasingly obvious that prevention of this disease is a microbiological problem. Future research will show whether or not it will be possible to increase the protective immune response of the individual patient by way of vaccination. At present there is no direct evidence that this principle can be utilized as a measure for preventing periodontal disease, but I should like to call your attention to the fact that vaccination of monkeys against cariogenic plaque streptococci has yielded quite conspicuous reduction in caries activity. As things are at the moment, however, there may be only one possibility of controlling periodontal disease, namely by preventing bacterial plaque from forming---Today toothbrushing and other mechanical cleansing procedures are considered to be the most effective means of controlling plaque, and in the individual patient who is well motivated and properly instructed, and who is willing to

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invest the time and efforts necessary to obtain oral cleanliness, these measures have most certainly proved to control periodontal inflammation. LOE, Harald. Present day status and direction for future research on the etiology and prevention of periodontal disease. J. Periodontology-Periodontics 40:678-682 Dec. 1969.

Conclusions: "The current situation is that trace element nutrition in relation to dental disease represents a field in which there is reasonable promise for the development of information of value in the improvement of dental health at a practical level. It is possible that particular trace elements may assist in the formation of better teeth either by influencing the solubility of the calcified dental tissues or by other effects such as producing small but important changes in the morphology of the teeth or by altering the crystallinity of the dental enamel. Many investigations with experimental animals have indicated that a wide variety of elements as well as fluoride may be dentally beneficial. While results of these experiments have been often contradictory, they have focused attention on the possible role of elements such as selenium, vanadium, molybdenum, boron and lithium either acting alone or in combination with fluoride. Preliminary evidence is also available to suggest that some of these elements may also affect the prevalence of dental disease in man....."

LUDWIG, T. G. Trace element nutrition in relation to dental disease. NZ Dent. J. 65:4-13 January, 1969.

SUMMARY AND CONCLUSION: "Correlation between plaque scores, bacterial flora, lactobacillus colonies & crevice depth were studied. No significant correlation existed between plaque and lactobacillus, lactobacillus and crevice depth, and plaque and crevice depth. Numerical increase for bacterial scores followed closely the numerical increase in plaque scores. Filamentous organisms followed plaque accumulation more closely than the other observed bacteria. Within the limitations of this study, the following conclusions are made 1) following a prophylaxis, there appears to be a relative correspondence between amounts of bacteria present in plaque and the amount of plaque scored by a clinical index. 2) the early rapid increase in plaque following a prophylaxis appears to be related to a dependent correspondence between filamentous organisms and/or a failure to adequately clean interproximal areas, 3) there is no apparent correlation between the amount of dental plaque and the number of salivary lactobacilli, 4) there is no statistically significant correlation between plaque scores and crevice depth in subjects without chronic destructive periodontal disease."

LYNCH, Marijane, Crowley, Mary C., Ash, Major M. Correlation between plaque and bacterial flora. J. Periodontology-Periodontics 40:634-635 Nov. 1969.



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SUMMARY: 1) The teenage patient as a future parent presents an excellent media to illustrate the current potentialities of dental care. 2) Effective prevention with an in-depth dental patient education program to augment clinical procedures is a more realistic approach to complex disease entities. 3) Fluoride is only the initial step in caries control not synonymous with a complete preventive program.

MALONE, William F., Sarlas, Chris H. and Buckman, James W. Ephebo-  
dontics and prevention aspects of oral health. J. Colo. D. Assn.  
48:35-39 Feb. 1970.

"It is apparent from this study that periodontal disease increases with age, calculus and poor oral hygiene....Oral hygiene, plaque formation and calculus, although an unholy trinity, do not constitute the total etiology of periodontal disease. There is ample evidence in all our clinical experiences and numerous examples in the epidemiological surveys of people with low oral hygiene scores and high periodontal indices, and conversely people in the older age groups with zero periodontal scores and poor oral hygiene. Obviously we are dealing with a complex disease entity with an interplay of many etiologic and defense factors. But we at least owe it to ourselves and our patients to aggressively combat these factors we know are significant and are amenable to treatment. Thanks to the efforts of the hygienic-industrial complex we have a generation of sophisticated weapons capable of dealing with bacterial hordes. Let us engage in anti-bacterial warfare."

MANDEL, Irwin D. Dental plaque: nature, formation and effects. J. Perio-  
dont. 37:357-367 Sept.-Oct. 1966.

Summary: "Saliva was collected from 30 girls at regular monthly intervals for 24 months. The lactobacillus count and the Snyder test showed a close similarity to each other and at least 74 percent of the tests showed complete or moderate agreement to clinical assessment of caries increment. DMFS increment was higher when the Snyder test was strongly positive and the buffer capacity was low, than when the Snyder test was strongly positive and the buffer capacity was high. The converse of this finding was also established. There was a fall in the buffer capacity before a sustained or subsequent rise in caries increment in over 75 percent of the participants. Clinical or radiographic caries was detected at a mean of nine months after the lowest point of this fall in buffer capacity."

MARLAY, Elaine. The relationship between dental caries and salivary  
properties at adolescence. Aust.D.J. 15:412-422 Oct. 1970.

"The effect of time of day, eating since the teeth were last brushed, and the number of stained teeth in smokers, on the oral debris index (Green and Vermillion 1960) was examined. The effects were found to be non-significant. Increased frequency of toothbrushing was found to produce a statistically significant reduction in oral debris."

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McKendrick, A.J.W., Barbenel, L.M.H. and McHugh, W.D. The influence of time of examination, eating, smoking and frequency of brushing on the oral debris index. J. Periodont. Res. 5:205-207, 1970.

Conclusions: "1) deposition of calculus may be accepted as an important factor of consideration in the treatment and prevention of periodontal disease. 2) Numerous investigations in vitro and in vivo of agents potentially capable of inhibiting the formation of calculus have been performed. 3) Studies to date have exhibited promise of developing an effective and safe agent to be used clinically. 4) Additional objective research now is necessary if such an agent is to become a part of the dentist's armamentarium against periodontal disease."

McNEAL, Donald R. Anticalculus agents for the treatment, control and prevention of periodontal disease. J. Public Health Dentistry 29:138-152 Summer Issue, 1969.

"A survey on 3,127 children, aged three to 18 has shown that 72.7 percent have periodontal lesions which began at age four and increased thereafter. The most acute lesions were found in the youngest patients. In certain age groups, the boys showed more lesions but hypertrophic gingivitis was seen among the girls only. The incidence of periodontal lesions was correlated with an abundance of calculus and plaque deposits, lack of good oral hygiene, severe malocclusion, and the presence of frenuli with high insertion on the vestibular fornix."

MIELER, I. and Reimann, H. Incidence of periodontal diseases in children and young adults aged three to eighteen years. Parodont Acad Rev. 2:101-109 Oct. 1968.

"In summary, subgingival calculus is first a product of periodontal disease and then a cause of its continued progression; it is one of the factors contributing to the cyclical nature of the disease. Its relationship to the periodontium is one of a parasite-host, wherein the virulence of the parasite and resistance of the host are everchanging. It is pathogenic because of the toxic bacterial plaque continually forming on its surface and because of its physical structure and growth which can impede gingival circulation and irritate adjacent soft tissues."

MOSKOW, Bernard S., Baer, Paul N., Hazen, Stanley P. and Turesky, Samuel S. In our opinion: What is the role of subgingival calculus in the etiology and progression of periodontal disease? J. Periodont. 41:283-286 May 1970.

Summary: "A brief account has been given of selected pieces of recent caries research\* which have direct practical significance. The role of micro-organisms information of bacterial plaque, and their ability to

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ferment sugars to form organic acids capable of attaching the tooth surfaces, has been emphasized, and various aspects of dietary control have been evaluated . . . . . It appears that it was first called plaque by Williams (1898). Bibby (1931) referred to it as a microbacterial film and Goldman (1953) called it *materia alba*. Dawes et al (1963) proposed the term "dental plaque" and argued that all other terms should be abandoned. They define this structure as: the soft, concentrated mass consisting mainly of a large variety of bacteria together with a certain amount of cellular debris, which develops within a short time of refraining from tooth brushing . . . . . It occurs, especially, approximately and at the gingival margins and also over carious lesions. It is not removed by rinsing with water . . . . . Although of course there is no evidence to support the view that caries is transmissible in man, this work does invite interesting speculation. For example, if it were to be shown that cariogenic organisms are passed from one human subject to another, or that members of a family harbour the same cariogenic oral flora, and that certain bacteria of the human oral flora have a cariogenic potential, then it should be possible to devise tests to establish caries-proneness and possibly discover an acceptable antibacterial agent specific for the particular organism or organisms involved. Further, it might be possible to elaborate a vaccine against the offending organisms, and encouragement for this approach was found when Bowen (1969) reported a pilot study in which there had been a considerable reduction in caries in three monkeys which had been given a vaccine when compared with three controls which had not. Bowen's findings should certainly encourage a reinvestigation of the immunological aspects of caries, an approach which in the past has been unfruitful and neglected."

\*Miller, 1890; Orland, 1954; Fitzgerald & Keyes, 1968; Bibby, 1931; Goldman, 1953; Carlsson & Egelberg, 1965; Guggenheim & Schroeder, 1967; Konig, 1967; Muhlemann, 1969, etc.

NAYLOR, M. N. The practical significance of recent caries research. Proceedings of the Royal Society of Medicine 62:15 Aug. 1969.

"Prevention in dentistry holds the promise for the realization of the goal of health promotion and health maintenance in daily practice by preventing the occurrence and progression of oral disease. Dentistry has evolved from a strictly technical pursuit of mechanical arts to an important branch of health service . . . . . The panacean objective is realized in dentistry. The discovery of bacterial plaque as the offender in the two disease entities that dentistry treats, and the establishment of a system of plaque control, represents the most important advance in the history of the profession . . . . . Much data is being examined and compiled in the field of immunology and the epoxy resins offer great promise in filamentous applications (only microns thick) that will seal off the tooth, rendering it totally impervious to oral fluids for years. Simple myoelectric systems will give details of muscle eccentricities and transducers will locate and guide the easy erasures of occlusal prematurities, thus eliminating another fundamental category in oral devastation . . . . . Never in the history of man in the broad field of medicine has there been a more magnificent potential. By its own dedicated application dentistry has found the

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capacity for 100 per cent eradication of the diseases which it treats. .... The foundation for this is research. Historically, great effort has been directed towards prevention, including the basic orientation of G. V. Black, founder of modern dentistry, who referred to microbial plaque in 1889. Dr. C. C. Bass instigated modern investigation and introduced the brushing technique that targeted the sulcular and crevicular areas surrounding every tooth. This was further explored and elaborated by Dr. Sumter Arnim, and many other unsung proponents of preventive dentistry. .... Anticipation and eradication are the purposes of preventive dentistry, coupled with the providing of procedures (preferably simple) for maintenance. .... The unraveling of the complex fabric in dental decay and periodontal disease was reported in recent conferences participated in by at least six countries; Sweden, Switzerland, Denmark, England, Canada and the United States. The cariologists and periodontologists agree that one basic home care technique will eliminate both diseases." The article then summarizes the material that has brought dentistry to this therapeutically-unprecedented threshold and concludes with: "Dental disease is caused by factors that are accessible, correctable and controllable."

NELSON, Stanley. Prevention: the dentistry of the future - the future of dentistry. N.Y.J. Dent. 41:54-57 Feb. 1971.

The most significant developments in caries research over the past decade follow: (1) The finding, in bacteria-free animals, that the oral flora is a prime requisite for initiation of dental caries. (2) The finding of an infective transmissible factor in experimental caries in animals. (3) The finding of a greater specificity of the bacterial flora involved in the etiology of dental caries, than previously suspected. (4) The finding from epidemiological data that smooth surface caries differs from pitted lesions in its statistical distribution and probably in bacteriological components. (5) The improved formulations and mode of application of topical fluorides. (6) The finding that certain strains of streptococci can induce plaque formation and multisurface cavitation in teeth of animals. This finding has implications in human caries. (7) The finding that sucrose serves as the substrate for dextran surase, and enzyme produced by streptococci which converts sucrose into a polymeric dextran or levan that adheres to teeth. (8) The finding that dextranase is capable of plaque dispersion in animals.

NIKIFORUK, Gordon and Pulver, Franklin. Practical aspect of current caries research and epidemiological data. Am. Soc. Dent. Child. 36:249-252 July-Aug. 1969.

- (1) Immunologic responses in humans to endogenous gingival micro-organisms from their own gingival crevices commonly occurs. All nine subjects examined had serum antibodies directed against their own bacteria.
- (2) In the other 70 human sera examined, almost all had antibodies to actinomyces. Many of these same individuals were allergic or hypersensitive to actinomyces. Both the antibody levels as well as

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the percentage of allergic individuals increased with increased severity of periodontal inflammation. These increases were statistically significant ( $p < .01$ ). 3) These findings indicate the existence of several immune responses to the gingival flora. These immunologic mechanisms may well be operative in human periodontal inflammation. Other types of study must now be undertaken to determine if those responses cause or modify human inflammatory periodontal disease."

NISENGARD, Russell J. and Beutner, Ernest H. Immunologic studies of periodontal disease. V. IgG type antibodies and skin test responses to actinomyces and mixed oral flora. J. Periodontology 41:149-152, Mar. 1970.

"The authors survey recent research in relation to the treatment of periodontal disease, notably marginal inflammatory disease. Marginal inflammatory lesions are attributable principally to irritation from bacterial toxins and since the disease begins in childhood it is essential that adequate prophylactic measures be instituted and early treatment given to children. Greater attention to cleaning in children would not only avoid gingivitis, but might prevent caries. A plea is made for complete reassessment of the relative importance of dental disease. The practicing dentist is often insufficiently concerned with the deterioration of the periodontium and frequently enhances the destructive processes by his own tooth restorative procedures."

NUKI, K. and Loe, H. The treatment of periodontal disease based on recent advances in research. Dent. Practit. Dent. Rec. 16:435-440, 1966. Abstract from J. Western Soc. of Periodontology-Periodontal Abstracts 15:27 1967.

"Much of periodontal disease is predominantly inflammatory in origin. It is the result of a local irritant, caused by an excessive collection of organisms commonly present in the mouth. It is neither an infection, a deficiency disease, a stagnation of food, predominantly a collection of calculus, nor is it due to a peculiar shape or structure of the periodontal tissues. Preventive measures would logically include increase of tissue resistance, control of immune reactions and prevention of the formation of the irritant or its removal. Prevention of the collection of the irritant could be approached either as a biological problem, in that growth of organisms could be suppressed, or as a mechanical problem. The present mechanical oral hygiene procedures are numerous, inefficient and time consuming and rely on skill and individual motivation. Chemically facilitated removal of the tenacious debris is hazarded as an urgent and important line of research....."

PARFITT G. J. Summary of the problem of the prevention of periodontal disease. Ala. J. Med. Sciences 5:395-402 1968.

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"The dental plaque is the common denominator of tooth decay and periodontal disease. The plaque is not food nor is it food residue nor is it just bacteria in the mouth. To the contrary it is a complex, metabolically interconnected highly organized bacterial system. It is the arch foe of oral health.....Both lactobacilli and streptococci are known to require carbohydrate in the diet. High levels of carbohydrate presumably would stimulate growth of both of these genera. We therefore are provided with an explanation as to why Lactobacillus counts are increased in individuals with active dental decay. Conditions of poor oral hygiene and high carbohydrate intake will commonly result both in decay and increased numbers of Lactobacillus and Streptococcus.....Two factors predisposing for decay are evident: 1) The non-repetitive preventative measure. The failure to continuously remove cariogenic flora from all tooth surfaces. 2) The repetitive initiating measure. The frequent intake of carbohydrate often of a single source which selects for and then feeds a specific cariogenic flora.....the removal of plaque bacteria by repeated rigorous oral hygiene can eliminate the microbial substances which produce the infection we term chronic inflammatory periodontal disease.....The dental plaque is thus the prime factor in most instances of tooth loss and first concepts of preventive dentistry must be directed against the plaque and its organized components."

PARKER, Richard B. Our common enemy. J. Am. Soc. for Preventive Dent. 1:14-17, 28-29, Jan.-Feb. 1971.

"The total stress born by the periodontium in a 24 hour period is 17-18 minutes. Other studies have demonstrated a force of 5-15 kg. of force per tooth during mastication and 40-50 kg. of force during swallowing. Normally the forces exerted act in a vertical direction and are supported by the periodontium. In the presence of prematurities, occlusal interferences, and encroachments of the freeway space, bruxism leads to the destruction of collagenous fibers of the periodontium and to tooth mobility. Early diagnosis of bruxism is important. Of 497 patients with periodontal pathosis, 88 percent were affected with bruxism."

PERDRIX, G. and Chambaz, H. Bruxism: its importance in periodontology. Ann Odontostomat (Lyon) 25:127-134, May-June 1968. (Abstract in Advances in Periodontics 1:18, 1971).

"Comprehensive Oral Hygiene is effective because: 1) Dentist cleans where patient cannot, and sets a standard. 2) Patient cleans regularly and when the dentist cannot clean. 3) Cleaning debris and caked-on plaque from interproximal areas permits circulation of fluids between the teeth and prevents stasis in the mouth. 4) Interproximal cleaning as well as brushing becomes a habit. Biological principles of oral hygiene provides a means of preventing, controlling and treating diseases of the mouth."

PETERSON, C. T. Some biological principles for oral hygiene care. Pakistan Dental Review 19:39-43 April, 1969.

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"Scientific and clinical evidence indicates that the teeth and supporting structures of man are formed to last a lifetime and that they are not doomed ontogenetically to early loss and phylogenetically to eventual extinction.....Periodontal disease is recurrent unless the patient changes his oral environment through the practice of scrupulous oral hygiene."

PRICHARD, John. Periodontal disease. Tx.S.J.Med. 58:78-84, Feb. 1962.

".....The World Health Organization rates chronic inflammatory periodontal disease as man's most prevalent disease. All epidemiologic studies point to inadequate oral hygiene as the primary etiologic factor in periodontal disease. In addition, human and animal experimental gingivitis studies have demonstrated that the disease can be produced simply by allowing the accumulation of bacterial plaque. These and other studies have also shown that when good oral hygiene is instituted and maintained, the disease process can be stopped and further destruction prevented. It can therefore be stated that there is a cause-effect relationship between not only bacterial plaque and periodontal disease, but also between bacterial plaque and dental caries....."

RATCLIFF, Perry. The economic advantages of periodontal therapy to the employer, the purchaser of dental care and the carrier. Periodontal Abstracts, The Journal of the Western Soc. of Periodont. XVII:9-10 Mar. 1969.

"A case is presented which graphically illustrates the direct interrelation between the patient's total physical and mental health and her oral and periodontal health."

REGENBAUM, Gary. Psychogenic aspects of periodontal disease. Case history. NYSDJ 36:609-612, Dec. 1970.

"The dentist must advise his patient in oral hygiene, the choice of toothbrush and dentifrice, and the proper technique of brushing. The teeth should be cleaned in the morning, evening and after every meal. Hard food requiring mastication is recommended. Eating should be limited to a few main meals. The state of plaques, calculi, and the oral hygiene index were studied in two groups of children, six to 15 years old. The greater quantity of plaques in the lateral teeth, as compared to the anterior ones, proved that without more energetic preventive measures, improvement of oral hygiene cannot be expected."

RIETHE, P. Prevention of periodontal disease in children. Deutsch Zahnaerztl Z 23:1271-1278 Dec. 1968. Abstracted in Advances in Periodontics 1:38, 1970.

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"The high incidence and rapid spread of pit and fissure caries on occlusal surfaces of newly erupted bicuspid and permanent molars has been a serious dental problem. An investigation was initiated to attempt to prevent caries in these areas by sealing them with an adhesive resin capable of forming strong bonds with enamel.....323 control teeth consisting of bicuspid and permanent molars were evaluated against an equal number of treated teeth. After two years the occlusal surfaces of 166 or 51.4 percent of the control teeth became carious, whereas in the adhesive sealed group 24 teeth or 7.4 percent became carious. This represents a reduction in occlusal caries activity of 85.6 percent in the adhesive sealed teeth over a two year period.

RIPA, L.W., Buonocore, M., Cueto, E. Adhesive sealing of pits and fissures for caries prevention: Report of two year study. IADR abstracts, 1966.

SUMMARY: "1) Bacteria have been proven to be essential to the development of dental caries in experimental animals. 2) characteristic streptococci have been found to be infectious and transmissible in producing dental caries in experimental animals. 3) Streptococci have been isolated from human subjects who developed carious lesions during a twelve month period of continuous observation. One of these organisms has produced dental caries in the rat. 4) Antibody titers against cariogenic streptococci in individuals developing caries have generally been found to be lower than titers in those who remain free from caries in the caries-immune program. 5) Phagocytosis with destruction of streptococci by leukocytes, is the protective mechanism against human streptococcal infections. 6) Evidence supports the contention that phagocytosis by leukocytes in the oral cavity is an active defense mechanism. 7) Vaccines are being developed which stimulate phagocytosis and destruction of streptococci that cause disease. Recently Wagner has reported that rats inoculated orally with Streptococcus faecalis and parenterally immunized with the homologous bacteria, demonstrated the virtual elimination of dental caries as compared to the non-immunized controls.....A vaccine to prevent dental caries is most certainly a possibility."

ROVELSTAD, Gordon H. What about a vaccine for the prevention of dental caries? J. Am. College of Dentists 35:74-81 Jan. 1968

".....Thus a total program for the prevention of dental caries today includes proper oral hygiene, control of sugar eating habits, fluoridation of water supplies, topical application of fluorides, use of fluoride dentifrices, early practice of exacting operative techniques, and thorough cleaning after meals.....In summary, the disease, dental caries, can be prevented by a cooperative effort involving the dentist, dental hygienist, patient and community".

ROVELSTAD, Gordon H. Current methods of dental caries prevention. North-West Dentistry 47:233-236 July-Aug. 1968.



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"There are five major factors responsible for dental caries. 1) susceptibility of patient. 2) microorganisms. 3) sugars of some kind. 4) some area of confinement of the microorganisms to the tooth. 5) optimal conditions for the disease.....The highest incidence of dental caries is found in the New England states, an area naturally low in fluorides in soil and water.....Dental caries is an infection. Recent studies have shown different types of streptococcus are related to dental caries. It has been shown in laboratory studies that the infection can be transferred from one group of animals to another. Those people that come to us caries free, one in 700 recruits entering Great Lakes, start with us with a perfect mouth, and within twelve months 46 percent of them have developed cavities. We have found that a similar type of organism has developed in the mouth of these individuals and increased in number. There are probably a number of bacteria causing dental caries that are transmissible from one individual to another.....To prevent dental caries we can reduce the susceptibility of the public by converted water supplies to that of optimum fluoride content. Topical fluorides will prevent or reduce caries in adults similar to children. Microorganisms-basically we are talking about removing of plaque, and control of infection. There may be a double-edged sword type of action from the fluoride. One is that it makes the enamel more resistant, and secondly, prevents the bacteria from flourishing."...

ROVELSTAD, Gordon H. The prevention of dental caries for the adult patient. J. Tenn.St.D. Assn. 48:257-259, Oct. 1968.

"The conventional Fischer rat has been used repeatedly for various studies without a single instance of caries. In the present study, using Fischer rats fed a noncariogenic diet similar to that of previous studies, massive caries occurred in mandibular first molars that were ligated with silk ligatures. Caries did not occur in any of the nonligated teeth of the same or control conventional rats. The findings were attributed to the action of bacteria and the prolonged food retention that occurred around the silk ligatures."

ROVIN, Sheldon, Shteyer, Arie, Howell, Robert M. and Gordon, Helmut A. Caries due to food retention in non-susceptible rats fed a noncariogenic diet. J.D.Res. 50:105-108 Jan.-Feb. 1971.

"In 1938, J. O. McCall alerted the profession that the foundation of virtually all adult periodontal disease was laid in childhood. This warning was emphasized by Paul Baer who stated that in many cases adult periodontitis must have had its initiation at the time of puberty in order to be responsible for the severe destruction at times seen in 20 to 30 year old patients. Parfitt further states that the early stages of periodontal disease are present before puberty and, left untreated, will inevitably result in destructive manifestation in the adult. Recently, Stallard expressed the belief that destructive periodontal disease often begins in childhood and is not recognized

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until the third decade, after irreversible changes have occurred. All agree that PERIODONTAL DISEASE IS A PROGRESSIVE, DESTRUCTIVE LESION OF THE DENTAL SUPPORTING APPARATUS THAT MAY HAVE ITS ORIGINATION IN CHILDHOOD OR AT PUBERTY, THE PROCESS THEN CONTINUING INTO EARLY ADULT LIFE AS AN OFTEN UNRECOGNIZED MARGINAL PERIODONTITIS. Ramfjord, Emslie, et al in their surveys indicate that the transition between gingivitis and periodontitis begins at about age 15."

RUBEN, Morris P., Frankl, Spencer N. and Wallace, Stephen. The histopathology of periodontal disease in children. J. Periodont. 42:473-484 Aug. 1971.

".....the number and size of cavities could be kept lower if certain defective crevices in the enamel of some teeth in the mouth were opened and filled before decay occurred. This procedure, called prophylactic odontomy, is excellent in the war against decay and is particularly applicable to the teeth of young children. Early detection and filling of cavities is still the simplest way, short of absolute prevention, to preserve teeth from the ravages of dental caries.....Although dentists realize that the battle against dental caries has not yet been completely won, they also know that more people than ever before are reaching old age with their own natural lifetime teeth, which are far superior to any artificial substitutes."

RUBIN, Marvin K. The war against dental decay. N.Y.J.Dentistry 39:420 Nov. 1969.

"One of the limitations of epidemiological study of periodontal diseases, despite their obvious infectious nature, has been the necessity of dealing with them as though they were diseases of unknown etiology. It is to be hoped that the current emphasis on oral microbiology (as exemplified by Dr. Socransky's paper) will lead to techniques and procedures which will permit the identification of the periodontal tissues under the autere conditions which frequently obtain in the field."

RUSSELL, A. L. The prevalence of periodontal disease in different populations during the circumpubertal period. J. Periodont. 42:508-512 Aug. 1971.

Author discusses etiology of periodontal disease, physiological control of plaque, motivation and education, toothbrushing (description and photos of brushes), toothpaste, interdental sticks, floss (photos of applicators), irrigation. Concludes with "The important role played by the patient in maintaining oral health cannot be too strongly emphasized. The patient's contribution to the prevention of periodontal disease is analogous to the control of obesity by dieting insofar as the application of preventive measures in both cases must be of lifelong

duration."

SAUNDERS, Maxwell. Preventive periodontics. Dental Health 10:7-15 Spring 1971.

"The ultrastructural nature of the interface between dental hard tissue and soft and calcified deposits was studied in undecalcified and decalcified thin sections from 28 extracted human teeth.....In conclusion, the ultrastructural study suggests that the attachment of a calcifying bacterial plaque depends, first, on the adhesive property of the organic intercellular matrix and secondly, on inorganic forces acting between crystals of calculus and underlying tooth substance."

SELVIG, Knut A. Attachment of plaque and calculus to tooth surfaces. J. Periodont. Res. 5:8-18, 1970.

"A previously proposed model of the effect of diagnostic error in dental clinical trials (J. Dent. Res. 47:142, 1968) permitted unbiased, interval-specific estimation of caries attack rates. This model, however, had two principal shortcomings: a) it did not incorporate the intuitively appealing concept of a "borderline" condition of tooth surfaces, wherein a diagnosis of caries-free or carious is equiprobable. b) the sampling distribution of the estimates could not be directly derived. A modification of this model has been developed which is consistent with the idea of three possible states of tooth surface (caries-free, borderline, carious). Estimation of caries attack rates are simply computed, and appear to be free from bias. An expression for the variance of the estimates has been derived which takes into account the fact that teeth are "sampled" in clusters, and is directly applicable to test of hypotheses."

SENNING, R.S. and Carlos, J.P. An improved method of estimating caries attack rates in dental clinical trials. IADR Abstracts, 1969.

146 women institutionalized - subjects .....mean age of subjects 27.32 .....object: give support to the proposition that there exists a strongly significant relationship between the Simplified Oral Hygiene Index and the Periodontal Index. Results: "Evidence as to the reliability and accuracy or validity of either technique cannot be supported by the data presented here."

SHAPIRO, Stewart, Pollack, Burton R. and Gallant, Dorothy. A special population available for periodontal research Part II. A correlation and association analysis between oral hygiene and periodontal disease. J. Periodont. 42:161-165 Mar. 1971.

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".....chronic periodontal disease is due to neglect; neglect of the healthy mouth thereby allowing bacterial plaque to accumulate; neglect of early periodontal disease permitting the disease to progress..... There is sufficient evidence available to institute rational measures for the total prevention of periodontal disease. However, extensive research should be directed at finding out about health motivation and methods of oral hygiene." (Author discusses toothbrushing, especially roll method and Bass method.)...."If the patient is highly motivated and has efficient oral hygiene he will not have plaque and therefore no periodontal disease or dental calculus will develop. However, very few patients achieve an adequate level of plaque control and therefore it is up to the dental therapist to remove the plaque and calculus..."  
SHEITHAM, Aubrey. The prevention and control of chronic periodontal disease. Dental Health 10:1-6 Spring, 1971.

"It is a curious fact that while dentists in general readily affirm that rampant caries is the result of a highly cariogenic diet and poor oral hygiene, they seem to have the greatest difficulty in accepting the idea that freedom from caries is achieved by a diet of low cariogenicity and good oral hygiene. There is an inexplicable predisposition to attribute the absence of dental caries to almost anything other than the lack of those factors which are known to cause the disease."

SIMS, W. The concept of immunity in dental caries. Oral Surg., Oral Med. & Oral Path. 30:670-677 Nov. 1970.

"Triad for periodontal health: Proper diet; proper home care; proper professional care. No lack of single part of this triad is capable of producing periodontal disease by itself. The lack of any two is certain to produce it, especially if one of the two that is lacking is proper diet, because this is the one factor concerned with function for the supporting structures and which is essential for the health of any organ."

SMITH, Joe H. Periodontal patients - a classification. Tx.D.J., pp 9-15, September 1962.

Conclusions: "Many, if not all forms of periodontal disease in humans are likely to be of bacterial etiology. There is little evidence of transmissibility of periodontal disease in humans, although such evidence exists for experimental animals. More than one type of microorganism from the human gingival crevice can initiate periodontal destruction in experimental animals which suggest the possibility that human periodontal disease may be a group of diseases. The ability of an organism or group of organisms to accumulate in large masses (ie. form plaque) appears to be a prerequisite for the initiation of periodontal destruction. The

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mechanism by which microorganisms lead to the destruction of the periodontium is unclear. Potential mechanisms involve the production of lytic enzymes, "cytotoxic" metabolites, or the initiation of chronic inflammation, possibly via allergic phenomena."

SOCRANSKY, Sigmund S. Relationship of bacteria to the etiology of periodontal disease. J.D.Res. 49:203-222 Mar.-Apr. 1970.

Author discusses the MANY factors which must be taken into consideration in prevention: Mucinous plaques; proper toothbrush instruction; orthodontics; early replacement of lost teeth; food impaction; habits; occlusion; diet....."It is extremely important to emphasize here that dental floss or tape should be used solely by dentists, and its use should not be taught or advised to the patient unless it is to be employed under the aforementioned conditions, (There are definitely limited indications for the use of the toothpick and dental floss. They may be helpful removing food from under a bridge. They may be employed where teeth are in torsion, and orthodontia has not been attempted or was deemed inadvisable).....The harm which may result from the use of the toothpick, dental floss and tape falls into two classifications: a) Harm from improper use is in the nature of irritation to the tissues which results in subsequent bleeding, gum recession, sensitiveness of soft tissues and teeth. b) Harm following the, so-called, proper use of the toothpick or floss, may include extreme damage to the dental apparatus. The toothpick and floss alleviate the effect but do nothing to remove the cause of the accumulation of food.....In most cases the responsibility rests with the dentist to formulate the means of preventing the occurrence of food impaction. Food impaction may be corrected by the following methods: a) grinding, b) interlocking, c) rebuilding by means of inlays, d) orthodontia, e) tooth extraction, and f) reconstruction of faulty restorations. A knowledge of the etiology of food impaction, of the pathologic lesions produced, and of how food impaction may be corrected is essential if one expects to practice this important phase of prevention.....Habits responsible for dental and periodontal disturbances include the following: lip biting; cheek biting; toothpick biting; abnormal occlusal habit resulting from nervousness; abnormal tongue pressure against teeth; finger nail-biting; pencil and fountain pen biting; biting on ear part of eye glasses; playing with artificial bridges and dentures; clenching of teeth in control of emotions; biting on straws, matches etc." .....Author goes on to discuss occupational habits and miscellaneous habits and concludes with "Much can be accomplished by paying intelligent attention to the subjects of food impaction and individual habit in the prevention of caries and periodontal disease. We should be vigilant to distinguish between giving temporary relief to a patient and the elimination of the cause that repeatedly calls for the administration of temporary relief."

SORRIN, Sidney. Preventive periodontics and the family dentist. N.Y.J. Dentistry 41:131-135, 143. April, 1971.

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"This report presents findings after two years of a three year study designed to determine if gingival inflammation and destructive periodontal disease are retarded in an oral environment in which optimum conditions of hygiene are maintained. Over 550 industrial employees between 18 and 40 years of age completed this phase of the study. Treatment and control groups were matched on basis of periodontal and oral hygiene status, past caries experience and age. Subjects in control group received no attention except for annual reexaminations, whereas the treatment group was given frequent dental prophylaxes and intensive oral hygiene instructions in addition to reexaminations. After two years, mean debris and supra- and subgingival calculus scores were greater for control group....The increase in oral hygiene score was more than six times greater for control group. Similarly, the control group showed more than twice the increase in gingivitis score as the treatment group, and more alveolar bone loss than the treatment group during the same period. The findings show that persons receiving frequent prophylaxes and personal instruction in oral hygiene have cleaner teeth, less gingival inflammation and a slower rate of alveolar bone loss than persons not receiving these benefits."

SUOMI, J.D., Greene, J.C., Vermillion, J.R. and Change, J. and Leatherwood, E.C. The effect of controlled oral hygiene procedures on the development and progression of periodontal disease in adults: Results after two years. IADR Abstracts, 1969. Also J. Periodontology-Periodontics 40:416-420 July, 1969.

"A three year study carried out to test hypothesis that the development and progression of gingival inflammation and destructive periodontal disease are retarded in an oral environment in which high levels of hygiene are maintained. The participants were primarily Caucasians of both sexes, 18 to 40 years old employed by industry. (The main experimental and control groups were composed of 163 persons each, the three smaller groups of 53 persons each.) (Groups matched on basis of periodontal and oral hygiene status, past caries experience, age and sex) During study period, several procedures were instituted to ensure that the oral hygiene status of the experimental groups was maintained at a high level; they were given a series of frequent oral prophylaxes, combined with oral hygiene instruction and dental health education. Subjects in the control groups received no attention except for annual examinations. They were advised to continue with their usual daily practices and visits for professional care. After three years the increase in oral hygiene score was more than four times greater in large control group than in the matching experimental group. Similarly, mean gingival inflammation scores were greater in control groups than in their matching experimental groups at each of the annual re-examination periods. The large control group also showed loss of epithelial attachment at a rate more than three and one-half times greater than in its matching experimental group during the same period. The findings provide strong evidence to support the desirabil-

ity of developing programs based on the improvement of oral hygiene, for the control of periodontal disease."

SUOMI, John D., Greene, John C., Vermillion, Jack R., Doyle, Joe, Chang, Jacqueline J. and Leatherwood, Ernest C. The effect of controlled oral hygiene procedures on the progression of periodontal disease in adults: results after third and final year. J. Periodont. 42:152-160 Mar. 1971.

"The effect on alveolar bone loss of maintaining high levels of oral hygiene for three years was determined from radiographs. The study population consisted of 192 persons, primarily Caucasians of both sexes, 18 to 40 years of age, who were matched forming an experimental and control group of 96 persons each. Measurements of alveolar bone loss were made from radiographs taken initially and at the end of the study of teeth in the lower right posterior quadrant. Subjects who received frequent oral prophylaxes and who were instructed in good oral hygiene practices showed less bone loss radiographically at the end of the study period than did the controls."

SUOMI, John D., West, Thomas D., Chang, Jacqueline J. and McClendon, Jerald. The effect of controlled oral hygiene procedures on the progression of periodontal disease in adults: radiographic findings. J. Periodont. 42:562-564 Sept. 1971.

SUMMARY: "Fifty gingival and 30 col biopsies were obtained from 39 adults under treatment for periodontitis. Histologic sections were prepared and stained with a modified Brown and Brenn stain, P.A.S. stain modified for fungi, and hematoxylin and eosin stain. The sections were examined for the integrity of the epithelium, amount of inflammation in the lamina propria, and the type and location of microorganisms present in these areas. The presence of bacteria within intact epithelial tissue was not observed in any of the gingival or col specimens. Five col specimens (17%) and six gingival specimens (12%), however, showed bacteria in the lamina propria associated with ulceration. In twelve gingival sections (24%) and seven col sections (23%), plaque was found at the epithelial surface. Streptococcus-like organisms were found in all of these cases. Since chronic inflammation was present in all tissue specimens without actual evidence of bacterial penetration, our data support the contention that gingival inflammation may well be the response to bacterial products rather than microbial penetration."

SUSSMAN, Harold I. The potential of microorganisms to invade the lamina propria of human gingival tissues. J. Periodontology-Periodontics 40:210-215, Apr., 1969.

"The occasional improper use of a toothbrush or interdental cleansers may injure the gingiva. This is a traumatic lesion which heals without permanent damage. However, the continued improper toothbrush techniques em-

played by some individuals could result in gingival recession.....  
 Materia alba accumulations as the result of poor oral hygiene or soft non-mechanical diets is also a frequent cause of gingivitis. Bacteria grow readily in this media producing toxins leading to gingivitis. The dentist should point out to the patient his deficiencies in oral hygiene procedures and dietary habits.....Microorganisms contribute to gingival pathology. The most common of these is the organism associated with necrotizing ulcerative gingivitis. This disease usually affects younger individuals between ages of 15 and 25. It can be treated easily by improvement of oral hygiene and the correction of systemic factors....."  
SWENSON, Henry M. The A B C's of periodontics-"L" is for local factors. J. Indiana D. Assn. 48:181-182 April, 1969.

SUMMARY: "Primitive man had and still has, caries-free teeth. But the use of heat in cooking and the advent of utensils enabling hot foods and drink to be ingested led to caries. Nature intends our teeth to cope with substances at or below body temperature; an unusual heat sensitivity is the underlying cause of dental decay.....All living tissues are heat sensitive. The solid matrix of the tooth is honey-combed by dentinal tubules; in these the processes of the odontoblasts extend. This is the peculiar feature of structure which might account for vulnerability to heat of a degree which would not distress the skin or flesh. Bone has a similar structure and is never subjected to temperature above that of the body.".....Note: Author has not taken hot food or drink for years and has not needed dental work. He says the contemporary passion for hot foods and drinks is not more than psychological conditioning.  
TAYLOR, S.W. Heat as the cause of dental decay. Pakistan Dental Review XVIII: 37-39, Jan. 1968.

Conclusion: "Various methods of inhibiting and preventing calculus formation have been attempted and some substances have proved to inhibit calculus formation to varying degrees. At present their use is not warranted. Therefore, the only practical way to prevent the deposition of plaque and calculus today is through a regular oral hygiene programme carried out daily by the patients themselves."  
THEILADE, J. and Schroeder, H.E. Recent results in dental calculus research. Int. D.J. 16:205-221 June, 1966.

SUMMARY AND CONCLUSIONS: "Carious dentin of human teeth including vital pulps from young and old males and root-filled teeth were studied microscopically. All of the carious dentin was invaded by streptococci. The carious dentin lost its polysaccharides. Young teeth showed arrest of invading streptococci in irregular dentin. The old teeth and root-filled teeth showed less aggressive invasion of streptococci. A discussion suggesting a relation between carious aggression and reduced water content



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in old and root-filled teeth was present."

TOTO, Patrick, Santangelo, Mario and Kwan, Hseuh-Wan. Dentin caries in aging teeth. Illinois Dental J. 39:20-24 Jan. 1970.

"Using Russell's system of classification and scoring for the prevalence of periodontal disease, 3275 individuals, twelve to 20 years of age, were surveyed. Greene's index was adopted for scoring oral hygiene status. It was found that the prevalence as well as the severity of periodontal disease increased with age. The oral hygiene index exhibited a rise with age establishing that debris and calculus were contributory factors in the initiation and progression of periodontal disease. A marked increase in severity of periodontal disease at 16 years of age was correlated with a deposition of subgingival calculus at this age. A decrease in periodontal debris, calculus, and oral hygiene scores at 20 years of age appears to be due to the consciousness towards oral hygiene at this age."

VACHER, B. A study of prevalence of periodontal disease. J. Indian Dent. Assoc. 39:5-9 April, 1967.

"The proportions of Streptococcus salivarius, and other zooglea-producing streptococci of the total facultative streptococci on Mitis-salivarius agar were determined in samples obtained from the lingual surfaces of both central upper incisors of nine subjects within 30 to 120 minutes after thorough prophylaxis. The percentages of Streptococcus salivarius on the tooth surfaces were much lower than those in samples of saliva or of the tongue tip obtained simultaneously. On the other hand, the percentages of other zooglea-forming streptococci, most of which were considered to be Streptococcus sanguis, were very high on the tooth surfaces but much lower in the saliva and tongue tip samples. The observed differences in ability to adhere to the tooth surface rather than in ability to grow on the tooth surface. These observations seem to provide an explanation for the relative proportions of Streptococcus salivarius and Streptococcus sanguis in mature dental plaque."

VAN HOUTE, J., Gibbons, R. J. and Banghart, S.B. Adherence as a determinant of the presence of Streptococcus salivarius and Streptococcus sanguis on the human tooth surface. Arch. oral Biol. 15:1025-1034, 1970.

"Calculus formation assessed by the WM-, CS- and MLC- indices was found to be approximately 50 percent greater when habitual brushing of the lingual area of lower incisors was not permitted."

VILLA, P. Degree of calculus inhibition by habitual toothbrushing. Helv. Odont. Acta 12:31-32 April, 1968.

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Conclusion: "This study was undertaken to develop correlations among certain characteristics of oral hygiene and the presence of oral protozoa. Findings revealed that many of these characteristics--eg., amount of heavy calculus, prevalence of mouth breathing, presence of mouth odor, coating of the tongue, and dirty mouth cavity--were age and sex dependent. The study also showed that the presence of E gingivalis and T tenax, two protozoa commonly found in the oral cavity, was a function of age and sex. A further ramification of the project was the confirmation that fluoride in a small quantity (1 ppm) in the drinking water does not significantly alter the incidence of these two oral protozoa. Finally, the rate of infection with the two oral protozoa was found to be directly proportional to the amount of calculus present on the teeth, the degree of coating on the surface of the tongue, and the progression of periodontal disease. The incidence of infection in all individuals studied was E gingivalis, 55.6 percent and T tenax, 29.1 percent. The results of the study indicate that investigators will find E gingivalis or T tenax in the oral cavity of 31 to 40 year old men who exhibit a heavy layer of calculus, a coated tongue, and advanced stages of periodontosis."

WANTLAND, Wayne W. and Lauer, Dean. Correlation of some oral hygiene variables with age, sex, and incidence of oral protozoa. J. Dent. Res. 49:293-297 Mar.-Apr. 1970.

"The effectiveness by which periodontal disease is prevented probably depends more upon the care the patient gives himself than upon therapeutic measures rendered by the practitioner.....the most important aspect of preventive periodontics should include the use of disclosing wafers or solution for plaque identification, a toothbrushing technique (combined with a fluoride dentifrice) that is "tailor-made" to the individuals needs, the utilization of unwaxed dental tape for debriding interproximal areas of plaque, and the use (oftentimes) of saline lavage and water pressure devices to aid in oral physiotherapy.....The type of toothbrush, method of brushing, and auxiliary aids for maintaining home care regime of satisfactory quality are dependent upon the needs of the individual. To avoid incorrect usage which frequently results in tissue laceration, habitual checks of the patient's habits of home care should be made.....with the prevalence of destructive periodontal disease among our population, no possible means exists for treating a majority of these patients. The only realistic approach to this problem relates to prevention of the disease. Since maintenance of periodontal health is a never-ending job, at no time can either member of the dental team, comprised of patient and dentist, relax his enthusiasm for the responsibilities THAT HE ALONE MUST ASSUME.....Bacterial plaque is a relatively invisible microbial deposit, covered by a seripermeable mucoid gel, that adheres to teeth.....When not removed, this microcosm increases in size and forms toxic waste products which produce inflammatory changes in gingival tissue. Careful and complete debridement of dental plaque is a fundamental part of preventive periodontics and becomes an absolute necessity in therapeutic endeavors designed to abort, control, or cure existing periodontal disease. Fortunately, bacterial plaque lends itself to

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removal by the patient, a procedure that must be instituted on a daily basis. At this point of understanding, a baseline can be established for initiating a preventive program in periodontics -- one relating to dental plaque removal."

WIEBUSCH, F.B. Preventive periodontics: an evaluation. J. Oral Med. 26:63-70 April/June 1971.

"Adoption of the living protoplasm theory would require changes in current thinking about plaque. Perhaps the most striking change would be recognition that variations in the oral environment known to affect plaque would act upon the living embedding material, the living cells, and the microbial load rather than upon the micro-organisms alone.... Possible implications of the theory to caries and periodontal disease cannot be predicted at this time."

WILDMAN, J.D. The living matrix of plaque. Dental Progress 3:183-186 April, 1963.

"Marginal gingival specimens of grossly inflamed tissues were sectioned at six microns. Antiserum flowed on section. Washed after 15 minutes incubation. Goat anti-rabbit globulin conjugated with fluorescein isothiocyanate flooded on slide. Ten minute incubation. Washed and coverslipped. Controls made by treating only with goat anti-rabbit globulin conjugate. All test sections showed green fluorescence. Controls were negative. There were three mitis antigens in the inflamed gingivae."

WITTWER, John W., Toto, Patrick D. and Dickler, Elliott H. Streptococcus mitis antigens in inflamed gingiva. J. Periodontology-Periodontics 40:639-649 Nov., 1969.

"One effective cleaning a day is sufficient to control most dental disease because it takes the bacteria approximately 24 hours to regroup once they have been disrupted. Recent studies have shown that coarse abrasive foods, chewing gum, mouth washes and water irrigation have little effect on controlling dental disease because they will not break up or dissolve organized bacteria. The best way available today to break up organized bacteria is with something mechanical. Many mechanical devices are available for this purpose with the most effective usually unwaxed dental floss and soft bristle toothbrushes....Who does one call when his house is on fire--the carpenter or the fire department? Stop the cause of the disease first! In order to reach this state of health, 360 degrees of each tooth must be maintained without plaque or organized bacteria. As long as the bacteria are organized they will continue to dissolve gum tissue and breakdown of a tooth structure. Unless a patient shows willingness to disrupt these bacteria, he cannot be considered a good candidate for further treatment. Any treatment in a plaque environment will

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ultimately fail and it is the responsibility of the dentist to teach the necessary skills that will create a healthy environment."

AUTHOR UNKNOWN: Prepared for Boulder (Colo.) Daily Camera (Newspaper) by the Boulder County Dental Society: Dental bacterial control and prevention: What it's all about. J. Colo. Dent. Assn. 50:54-56 Aug. 1971.

#### IV. PATIENT EDUCATION - PHILOSOPHY - MOTIVATION

"The effects of a closely supervised oral hygiene program in Antarctica are reported. The dentist lived for over a year at Little America, V, Antarctica in day to day contact with experimental group. (103 men - mean age 28.3) Results showed that a remarkable state of oral cleanliness could be obtained by emphasis of the proper tooth brushing techniques as well as emphasis on importance of oral hygiene. This condition was brought about by an increase in both total and effective (after-eating) toothbrushing. These results did not occur following group lectures and movies, but came only after concentrated personal contact and personal effort on the part of the dentist and the formation of close association between dentist and patient."

ADAMS, Robert J. and Stanmeyer, William R. The effects of a closely supervised oral hygiene program upon oral cleanliness. J. Periodont. 31:242-245 July 1960.

Amenta: "I think there's a lot of confusion about preventive dentistry. Many people think of it as a specialty, where it's not a specialty at all. It is a philosophy of treating the cause of the disease before you address yourself to the results. Unless you can control the cause, it's rather ludicrous to be chasing the results. And I think chasing the results has put the dental health care of the nation in a state of near crisis."

AMENTA, Charles; Corn, Herman; Haselnun, Dan; Mittelman, Jerry; and Reed, Omer. Making prevention pay - round table discussion. Dental Management 11:23-48, June, 1971.

"The challenge to dentistry then is providing the environment and instruction so that every patient can learn what is necessary for complete dental health. The problem is with the dentist who cannot or does not want to teach patients to have good dental health, or the dentist who does not believe it is an important part of his profession. Who benefits? The patient, the public in general and the doctor. The patient benefits by having a prettier smile, a more comfortable mouth and lower future dental expenses; the public because patients become missionaries and to teach preventive procedures to others--and lastly, I benefit because I am doing exactly what I want to do."

ANDERSON, Dr. Jack L. Preventive dentistry: a change in direction. Practice Administration 7:3-4 Summer, 1970.

"Excellent oral hygiene is not easily attained or simply maintained. It requires the use of psychology in patient education, motivation and instruction. Constant and rigid patient control with their oral hygiene coupled with regular professional dental treatment is the greatest need of preventive dentistry today. Ironically, all of the professional

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treatment in the world is futile if the patients fail to maintain excellent oral hygiene. Psychologically patients need a concise program and a definite oral brushing technique such as 'The five by five Brushing technique' to follow in maintaining their dental health. Brush five pressure-and-turn strokes to each gum and tooth surface, five times a day."

APP, George R. An oral brushing technique for rigid patient control. J. Periodont. 37:62-63 Jan.-Feb., 1966.

Each author answers this question separately. From Ariaudo's opinion: "...from an evaluation of the gingival health of 100 patients who had been on recall for varying periods,....the least gingival inflammation and the greater number of plaque free teeth were in patients who spent the most time on oral hygiene.....The patients who scored the best spent at least 25 minutes a day with their oral hygiene procedures.... Since 30 percent scored 'excellent', it appears that 70 percent probably were not properly motivated.....To achieve this motivation, author describes his four phase plan: 1) pamphlets for patients to explain problems of periodontics. 2) Evaluation of techniques used by the patient and those of value incorporated in an oral hygiene prescription for that patient. 3) motivation through positive instead of negative reinforcement (function, safety, social esteem, self-realization) and praise. 4) recalls." From Arnim's opinion: "Theoretically the time elapsed from total cleanliness to microcosmal maturity would determine the 'necessary' frequency of effective oral hygiene procedures for maintenance of gingival health. This time interval is a little as three days in the mouths of some patients and as long as ten days in others.....The fact that effective procedures do not have to be performed four times daily or even two times daily for maintenance of gingival health makes it easier for the dentist to obtain the patient's cooperation. The tests (disclosing solution and phase microscope examination) are repeated during recall appointments as added motivators....." From Greene's opinion: "Studies have shown that little stainable plaque is found on the teeth within 24 hours after they have been thoroughly cleaned. There also is evidence that the longer the plaque remains undisturbed, the greater the prevalence and severity of gingival inflammation. Thus, based on this evidence - though to my knowledge it has not been demonstrated in a human population study - thorough cleaning of the teeth once every 24 hours should be sufficient for maintaining gingival health if the procedures are, in every sense of the word, effective.....To be truly effective they must include the use of tape or floss in addition to brushing so that plaque and debris will be removed from all surfaces of the teeth, including the interproximal surfaces.....The increased frequency of brushing is suggested for those patients whom the practitioner has yet been unable to get to clean interproximally every day or whose brushing is not adequate; this is in recognition of studies which have shown a positive relation between brushing frequency and gingival health. These studies did not consider quality of brushing but did show that brushing

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two and three times daily results in improved gingival health. It may be that chances for plaque removal are increased as the brushing frequency is increased, even though one would expect that since most people develop a pattern of brushing, the same areas would be missed regardless of the frequency. This may explain in part, the lack of a straight line relationship between brushing frequency and gingival health. Even in patients who report a brushing frequency of three times daily, plaque and gingival inflammation are still common." From Loe's opinion: "..... that oral cleanliness be regarded as a defined state in which all surfaces of all teeth are plaque free. Starting from zero level, it may not be surprising to find that complete removal of plaque once daily or every second day, or possibly even once every third day, is more valuable from the point of view of preventing dental disease than performing two or three inadequate brushings per day.....Just as no two dentitions are identical, no one method of cleansing is adequate for every dentition. Therefore a specific oral hygiene program must be designed for each patient." ARIAUDO, Arnold A.; Arnim, Sumter S.; Greene, John C; and Loe, Harald. In our opinion: How frequently must patients carry out effective oral hygiene procedures in order to maintain gingival health? J. Periodont. 42:309-313 May 1971.

"Approximately 24 to 48 hours is necessary for the plaque material on the tooth surface to grow thick enough to bring about rapid acid production. Consequently, by removing this material at least once a day, it is possible to eliminate one of the chief items in the cariogenic process. This technique is one that must be taught individuals before they are able to use it effectively. Plaques must be stained and dental floss used to remove the material from between the teeth. Soft bristle toothbrushes are used to remove plaque from the cheek, on the tongue and tooth surfaces. In order for the patient to have a check on the effectiveness of their attempts to clean these adherent masses or organisms from the teeth, it is necessary to use the stain at home. They can see the organisms in their own mirrors and use the stained plaque as a guide to effective removal."

ARNIM, Sumter S. Prevention and treatment of dental caries. Seminar presented at Pediatric Postgraduate Seminar, Baylor University College of Medicine, April, 1952.

"We can summarize by saying that a tooth once fully formed is extremely resistant to destruction. Only acids readily demineralize a well-developed tooth. In the mouth such acids are derived from our highly refined foods. Sugars and other fermentable carbohydrates are acted upon by enzymatic mouth bacteria on tooth surfaces to form acids. This process is repeated until the inorganic salts are dissolved and a hole develops in the tooth. This loss of tooth substance is known as dental caries.... When one eats refined foods, he should clean and rinse them from the mouth

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as soon as possible so they will not form a substrate for bacteria to produce acids and toxins that destroy the teeth and gums. Every person, especially after eating at night, should brush his teeth, clean between them with dental floss and thoroughly rinse all debris from the oral cavity. The object of these procedures is to remove bacteria and food from tooth and gum surfaces. The success of the treatment is directly related to its thoroughness."

ARNIM, Sumter S. Nutrition and dental health. Food and Nutrition News 26:1,4 Jan. 1955.

"The object of personal oral hygiene is removal of the microorganisms. The disclosing solution tells the tale and is all revealing in this respect. Final responsibility for success of treatment rests with the patient only. Microbial populations regenerate too quickly for the practitioner to assume this responsibility. The patient who uses a disclosing solution regularly knows when he is discharging the responsibility successfully."

ARNIM, Sumter. Thoughts concerning cause, pathogenesis, treatment and prevention of periodontal disease. J. Periodont. 29:217-233 July 1958.

"The cleansing technics recommended follow the teaching of Bass and Smith. Best results are obtained by emphasizing the basic causes of dental disease. The patient is taught that the microcosm is the chief cause of 'tooth decay', 'pyorrhea', and 'halitosis'. He is shown how to use an antiseptic fuchsin disclosing solution, how to see and recognize the germs on teeth, and how to remove them effectively. The disclosing solution also proves to him that the germs grow back every 24 hours and thereby puts the responsibility for a clean and healthy mouth directly in his hands, as he is the only person who can remove the microcosms daily. He learns to develop his own technics for this purpose, using several or all of the generally accepted personal oral hygiene measures of brushing, flossing, rinsing and massaging."

ARNIM, Sumter S. and Williams, Quinton E. How to educate patients in oral hygiene. Dental Radiography and Photography 32:61-65, 1959.

"Teen-agers have a higher incidence of tooth decay than any other group. If they could be motivated to clean their teeth effectively, much damage to teeth and gums could be prevented. Most teenagers are 'from Missouri', but if they can be shown, if they can see evidence which is presented in an interesting way, they will be convinced." (article describes scientific demonstrations: the production of acids by microbial masses on the teeth, the effect of acid on teeth and using disclosing solution to demonstrate speed of growth of microbes.)



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ARNIM, Sumter S. and Sandell, Perry J. How to educate high school students in oral hygiene, J. Health-Physical Education - Recreation p. 33, Oct. 1960.

"In summary, it has been my purpose to share with you a prized possession, an acquaintanceship through his writings with Antony van Leeuwenhoek. He told us in September, 1683, 279 years ago that his teeth remained clean and white as befell the lot of few men his age (about 51) because he was wont to cleanse them daily with cloth, salt, toothpicks and a swill of water. He saw, nevertheless, some white matter sticking to them in which he recognized with the aid of his simple microscope, living bacteria which probably were bacilli, selenomonas sputigena, micrococci, leptotrichia and spirochetes. In addition he drew our attention to the inability of a mouthwash made of vinegar to penetrate and kill the microorganisms in the scum on his teeth. This is the first recorded observation indicating the presence and protective nature of the gel within which the microcosms of the mouth thrive. He also related mouth odor to mouth bacteria. May I suggest that now, in 1962, when microscopes with phase optics can be purchased for much less than some dental handpieces, that we also gaze into this tiny world inhabited by Leeuwenhoek's little animals and share with him great wonder and delight ..... Perhaps if we record our observations as accurately, simply and honestly as he did, and speculate thereon as wisely, new discoveries will be made of great value for the prevention of dental disease and the preservation of oral health."

ARNIM, Sumter S. Antony van Leeuwenhoek - the first periodontist. Academy Review of the Calif. Academy of Periodontology 10:57 July 1962.

"Successful prevention depends primarily upon an understanding of the facts relating to dental disease and the diligent practice of regular, effective hygiene and nutritional habits." (Article describes instruments for personal oral hygiene, and case reports presented) "Little talking is required after patient sees red blobs of 'germs' on his teeth through use of disclosing stain. He wants to get them off. They are easily removed with soft, round-end bristle toothbrush. Soft, round-end bristles are used to prevent injury to the gum when the bacteria are dug from the crevice between gum and teeth."

ARNIM, Sumter S. Prevention of dental disease. Pediatric Clinics of North America 10:275-287, Feb. 1963.

Article describes personal oral hygiene instruments, technics of use, methods for evaluation of results and means for motivating learning and continued application, and includes case reports.... "Dental floss is used to clean the approximal surfaces of the teeth. A thin, strong, unwaxed floss is preferable as it will leave no wax fragments on teeth or in gingival sulcus. Instruments recommended for personal oral hygiene

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must be easy to use, comfortable and habit forming; otherwise they retard rather than speed the learning process."

ARNIM, Sumter S. How to teach prevention and control of dental disease. Bulletin Phil. County Dental Soc. 28:12-18, 1963.

"The profession is dependent upon the patient for ultimate success of any therapeutic procedure, as the microbiotas associated with the initiation and maturation of periodontal lesions begin to grow back as soon as the dentist completes his treatment. Consequently best results are obtained when patients learn that the microcosms, as revealed by disclosing dyes and microscopic examination, are significant local factors in the etiology of periodontal disease. Then their knowledge of the essential nature of this insidious ailment will serve as a motivating stimulus to the necessary, regular, thorough, personal oral hygiene which results in effective prevention."

ARNIM, Sumter. Microcosms of the mouth - role in periodontal disease. Texas D. J. 82:4-10 March 1964.

"It would be apropos to plagiarize Parmlly and entitle this paper, 'The Natural History and Management of the Teeth, the Cause of their Decay, the Art of Preventing its Accession and Various Operations Suggested for the Preservation of Diseased Teeth'. This is the title of a booklet he published and sold to his patients and public 140 years ago. His title aptly describes the content and order of presentation of the subject matter of this essay.....Inhibition and prevention of microcosmal growth is easily accomplished with five simple hygiene instruments: irrigating syringe designed in accordance with specifications found in early and recent literature for gently flushing the serous residues from the sub-gingival spaces which provide microcosms with a constant, rich nutrient supply. Second, unwaxed floss manufactured in general accordance with Bass specifications and designed so that it will slide beneath the edge of the gingival crest where it may be pulled closely against the approximal tooth surface, dislodging microbes and cellular residues from the area as it is drawn occlusally. Third, soft round end bristle brush manufactured in general accordance with the Bass specification. Fourth is a therapeutic dentifrice, and fifth, disclosing wafer which marks the microcosms red, showing the patient exactly where the teeth need cleaning at the sites where periodontal disease and dental caries begin. The hygiene kits provided patients at the University of Texas Dental Branch have instructions which follow closely teachings of Black, Kells, T.E. Smith, and Bass, modified in detail but not in principle, during 17 years of clinical experiments and study."

ARNIM, Sumter S. Dental care for the child patient by the family dentist. N.Y.J. of Dent. 35:37-56 Feb. 1965.

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"To date, the only reliable method known for removal of the cause of dental disease is thorough, complete and judicious personal oral hygiene. This means someone must clean all tooth surfaces effectively often enough, to prevent development and maturation of the periodontal and carious microcosms if the preventive program is to be effective. Bacterial plaques must be located, visualized and disrupted before they reach a thickness, volume and metabolic potential capable of energizing the mechanisms responsible for the creation of the lesions known as 'tooth decay' and 'pyorrhea'.....Since success of a preventive program is primarily in the patient's hands, the dentist must learn a new operation. This operation requires no handpiece, anesthetic, bur, or impression material. It does entail enlightening communication, persuasive motivation and exacting evaluation. The doctor's success is dependent upon his skill as a teacher who educates patients to perform hygienic practices regularly and thoroughly."

ARNIM, Sumter S. How the dentist can help people learn to prevent and control dental disease. North-West Dent. 45:3-15 Jan.-Feb. 1966.

Dr. Arnim's lecture devoted to consideration of modern concepts of maximal oral health and the initial changes which herald the advent of dental disease. Case reports and materials described are on file at The University of Texas Dental Branch and available to those interested. In summary, Dr. Arnim states:...."only the dentist has the knowledge to detect periodontal disease, preferably at the earliest stages. At that time he can demonstrate the presence of the biomasses associated with the disease to patients. This is easily done with disclosing wafers and phase microscopy. The next step is to help remove the noxious microcosms effectively. Evaluation of the effectiveness of this program for oral health is made during subsequent appointments." Dr. Chad McCoy's impression of Dr. Arnim's presentation: "This concept of oral hygiene changes the emphasis from method to results. The patients are shown how to clean their teeth, not how to brush. The dentist helps each patient develop an individual program using soft brushes, dental floss, irrigation, and disclosing tablets. His principal contention is 'Don't believe what I say - try it!'"

ARNIM, S.S. Report of the Annual Workshop (Council on Dental Health of the Missouri Dental Association) J. Missouri D.A. 46:8-11 Apr. 1966.

"Steps in the program for prevention of disease and maintenance of oral health are: 1) Show the patient the tenacious microbial masses adhering to the teeth that were missed with routine brushing. Disclosing wafers are used to dramatize the presence of the "invisible germs". Explain that these microbial clumps are associated with dental decay and pyorrhea. Allow the patient to learn for himself how easily the masses are removed. This can be done with toothbrush or toothpick. 2) Help patient learn to remove the microbial masses that are the cause of tooth decay. Patients

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are usually anxious to remove the microcosms when they see the red stained blobs on their teeth. Give patient reprints, instruction pamphlets and the necessary aids for complete personal oral hygiene (brush, floss, water spray, disclosing wafers). 3) Recall appointments are essential for successful preventive programs to help patient locate these invisible masses, and to remove those he can not. 4) Radiographs and photographs are valuable parts of program. They serve as visual proof of effectiveness of procedures. 5) Supplementary aids: fluorides in drinking water, therapeutic dentifrice, and topical applications are recommended. The goal of an effective personal oral hygiene program is to control dental disease by removal of the microbial masses associated with causation, the methods for accomplishing the goal are varied as occasion demands."

ARNIM, Sumter S. An effective program of oral hygiene for arrestment of dental caries and the control of periodontal disease. J. So. Calif. Dental Assn. 35:264-280 July 1967.

"Article is case report of a clinical test of the role of personal oral hygiene; toothbrush, floss, dental irrigator and dentifrices; in the control of dental disease. A 'hopeless' case was chosen which had failed to respond to treatment for dental caries and periodontal disease over a period of many years in spite of regular visits to the dentist and 'proper' tooth brushing. Disclosing wafers, sedimentation tests, scrapings and phase microscope analyses were used to detect, demonstrate and measure the microbial elements associated with the dental lesions. Biopsies were taken of marginal gingiva in order to determine the histopathologic picture from the beginning of the experiment until the end. All the laboratory tests were used as aids in the development of the treatment plan and as guides for measuring the effectiveness of the program as it progressed. The results obtained were dramatic. They were documented clinically and with the tests in a few weeks both caries and periodontal problems have been controlled in this patient's mouth for six years. It is recommended that all dentists use these simple scientific procedures in daily practice to help their patients develop an effective program for prevention of dental disease and preservation of oral health."

ARNIM, Sumter S. The effect of thorough mouth cleansing on oral health - case report. Periodontics 6:41-52 Feb. 1968.

"I personally believe that showing a patient the tenacious microbial masses adhering to his teeth is the most important step in a program for preservation of oral health....Hitherto in preventive dental education we have had to work with crude tools. Now we have heavy artillery in the form of motion pictures which show up to 24,000X magnification of actual microorganism growth and movement." (article describes equipment and technique for cinemicrography at The University of Texas Dental Branch.)

ARNIM, Sumter S. Photographing oral bacteria. Visual/Sonic Medicine 3:29-31 Aug.-Sept. 1968.

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"It is recognized that an essential phase in periodontal therapy is education of patient for maintenance of adequate oral hygiene. Without such cooperation on part of patient, any therapy is destined to failure. To evaluate the long term effects of such educational activities, a group of 100 periodontal patients were evaluated by questionnaire as to attitude toward preventive periodontal measures, occupation, education level and other pertinent areas. In addition, the status of oral hygiene was evaluated utilizing the oral hygiene index simplified. One year following periodontal treatment, 89 patients returned for a recall appointment at which time they were evaluated again as described above. Patients divided into groupings by age and sex for analysis. It must be assumed that patients accepting periodontal therapy are more motivated than the general public and those willing to return for periodic care are even further motivated. In spite of this, a difference was apparent between males and females, with the females demonstrating the highest degree of retention of both sound attitudes towards a periodontal preventive program, as well as effective oral hygiene procedures as evidenced by lower OH-S scores. The extremes on both ends according to age (below 30 and 60 and over) exhibited the lowest OH-S scores in both the males and females. A marked deviation from the norm was noted in the case of the 40 to 49 year old males. Their oral hygiene scores and attitudes were significantly worse than any other group."

AWWA, I.A. and Stallard, R.E. Evaluation of the long term effectiveness of periodontal patient education. I.A.D.R. Abstracts, 1969.

"While the effectiveness of any periodontal therapeutic procedure is in itself important, the overall success of the case is dependent on the patient's acceptance of the concepts of personal oral hygiene and the implementation of these techniques. Education of the patient alone, however, was shown to be only one of the factors involved. The patient must also be motivated and herein were found definite psychological problems requiring action on an individual or group basis. It is, therefore, imperative that these factors be taken into consideration in any periodontal therapy as the prognosis of the case will be worsened if they are ignored."

AWWA, Issam and Stallard, R.E. Periodontal prognosis: educational and psychological implications. J. Periodont. 41:183-185 Mar. 1970.

"There is no single formula, this practitioner discovered. Every doctor must evolve his own philosophy, and his own methods for teaching it to patients.....False teeth! The ultimate failure following 32 consecutive failures. On this is our antiquated Patch and Mend philosophy based." (Author lists ten reasons for making a preventive practice succeed.)  
BARKLEY, Robert F. Why a preventive practice fails....and how to make it succeed. Dental Management, 73-80, June, 1971.

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"Comparison between patient education and oral health status was made and subjected to statistical analysis. The data indicated that the higher the level of patient education, the better the level of oral health."

BENNETT, Warren L. Patient education: a factor in oral health status. I.A.D.R. Abstracts, 1966.

"The purpose of dentistry as a health profession must be understood and wanted by dentists! In order for the public to benefit, the help must come from the dentist, who must be taught to use and must use preventive dentistry as an active part of his practice. To best use his skills and knowledge in the promotion of oral health an individual dentist must have the cooperation of the local and national dental societies. 'Soap and education are not as quick as a massacre, but they are more deadly in the long run!' (Mark Twain)."

BERDON, John K. The prevention of periodontal disease through education. West Virginia D.J. XLIV:12-14 Jan. 1970. (Also under the title of Education for prevention of periodontal disease. J. Canad. Dent. Assn. 36:382-383, Oct. 1970.)

"Aim of investigation was to study whether programmed self-instruction in oral hygiene, given once, could increase the subjects knowledge and also whether this resulted in more effective oral hygiene as measured by the accumulation of dental plaque and the state of the gingivae. ((94) recruits of Swedish Regiment - 18 to 22 years of age.) The self-instruction program was read by experimental groups on a single occasion. The level of oral hygiene was assessed before the instruction, after one week, and again after one month. The subject's knowledge was improved and retained. The plaque and gingival scores were significantly reduced....In view of its efficiency, and the fact that it can be adapted for various purposes, it is concluded that programmed self-instruction is a valuable method for teaching oral hygiene."

BRATTHALL, Douglas. Programmed self-instruction in oral hygiene. J. Periodont. Res. 2:207-214, 1967.

"This study has revealed that when three posters concerning dental decay were placed in primary schools without comment, less than one-fourth of the children were apparently assisted in gaining selected information. There was widespread knowledge about much that was contained in the posters. In no case was misinformation totally overcome. Implications important for future poster design are apparent. It is necessary to know whether the group to which the poster is directed already know the facts to be conveyed. Whether or not the children can be motivated to put them into practice is a different problem. The cost of production and distri-

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bution of aids to health education is considerable and warrants the added expense of engaging graphic designers and educators as well as health personnel in the planning stages."

BROWN, John P. A study of posters in dental health education. Aust. D.J. 14:312 Oct. 1969.

Author reviews types and criteria for selection of educational aids and lists sources of patient education aids.

BUSHEY, Robert S. Patient education aids: are they effective? J. Colo. Dent. Assn. 49:24-28 May 1971.

"The author provides an area devoted exclusively to teach preventive oral hygiene. The teaching approach places great emphasis on letting the instructees see the nature of the problem and their own progress. Extensive use is made of a sound film, models of the teeth and mouth and a phase microscope. The instructees learn the value of the disclosing wafers, the small soft nylon brush, and the unwaxed dental floss. An advantage of an instruction area is that instructees can themselves floss and brush under supervision. The experience of utilizing the floss and brush cannot be surpassed as a teaching method, especially when disclosing wafers and the microscope tell them when they are or are not progressing."

CANFIELD, Earl R. Meeting the challenge of preventive dentistry. J. Ga. D. Assoc. XLIV:24 Winter, 1971.

..."In light of what is known about the cause, control and treatment of oral disease, there would appear to be no rational justification for this expectation of inevitable loss of teeth because the oral diseases most responsible for the loss of teeth can be prevented.....Why then, do people not believe us? The answer is simply that we do not deliver what we promise. Many people who go to dentists regularly still lose their teeth. They lose them because too many of us practice dentistry as an after the fact disease repair service rather than as a before the fact disease prevention and control service.....Progress made in health care in recent years has been characterized as being the building of better mouse traps when the problem is elephants."

CASSIDY, James E. The problem is elephants (why preventive dentistry - part I) J. Am. Soc. Preventive Dentistry 1:6-9, 16, 30. Oct. 1970.

"The concept of public oral health is an abstraction and does not exist except within an individual. It assumes a different significance and value in various persons, depending partly on the environment in which

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they live.....In a given place and time there is a level of public oral health beyond which it is impossible to go. This level must be reached while awaiting better economic conditions which will permit the health level to rise further."

CHAVES, Mario M. Better oral health for America. A.D.M. 24:643-652 Nov.-Dec. 1967. (Abstract in Advances in Periodontics 1:37, 1970.)

(detailed study - 19 tables included)....."although the public reports that they brush their teeth to reduce dental caries, clinical research suggests that toothbrushing is effective chiefly in reducing or preventing periodontal disease. Because of the lack of coincidence between public opinion and professional research, strong, effective and corrective dental health programs must be carried out to adjust oral hygiene beliefs and practices."

COHEN, Lois K.; O'Shea, Robert M; Putnam, Wm. J. Toothbrushing: public opinion and dental research. J. Oral Therapeutics and Pharmacology 4:229-246, Nov. 1967.

"Patient motivation as it relates to periodontal disease and its treatment should result in a happy and cooperative relationship between patient and dentist. The patient should be dependent upon the dentist only for things which he cannot do for himself. Daily plaque control is his personal responsibility and no dentist should assume responsibility for the patient's part of therapy. Plaque control by the patient should be initiated as soon as possible in the treatment plan to emphasize its importance. Early participation by the patient will teach the desired behavior and thereby change patient attitudes positively toward dental care. All facts of the treatment plan performed by the dentist should be related to oral hygiene. For example, orthodontics, straightens the teeth, which in turn makes oral hygiene more possible, and pocket elimination by periodontal surgery is mainly done to facilitate oral hygiene. Above all, the dentist and his auxiliaries must be absolutely convinced of the value of periodontal therapy and plaque control."

DERBYSHIRE, John C. Patient motivation in periodontics. J. Periodont. 41:630-635 Nov. 1970.

"Two hundred fifty-four children examined on eight occasions by the same dentist throughout a six and one-half year period. (Dental health campaign from Nov. 1960 to March 1961). It is shown that the campaign did not create a definite interest in oral hygiene in all social classes but the interest and improvement were maintained over a much longer period in the children attending schools in the 'above average' social grade. It has also been shown that campaigns alone are only a means of focussing attention on the subject and that there should be some form of routine



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dental health education programme to maintain the interest created by campaigns."

FINLAYSON, D.A. and Pearson, J.C.G. Dundee dental health campaign. A study of its value six years later. Brit. D.J. 123:535-562 Nov. 21, 1967.

"The purpose of the study was to determine the effect of concentrated periodic education in oral hygiene on the rate of return of dental plaque following a prophylaxis. Eighty non-dentally oriented subjects randomly assigned to two groups. Subjects in Group I (control) were scored for plaque prior to a prophylaxis and at 3, 7, 14, 21, 28, and 60 days following the prophylaxis. Subjects in Group II (experimental) were given four new brushes and toothbrush instruction at 3, 7, 14, 21, 28 days; disclosing tablets, written instructions, printed material on dental care and at chairside were shown color slides and a four minute movie produced by the U.S.A.F. titled "Patient Education Information". Subjects in both groups were scored again at 60 days following the prophylaxis. A statistical analysis of the data showed a significant difference between the two groups in plaque scores from 14 to 28 days, but no difference between 60 day scores in the two groups."

GARDNER, Joan I. and Ash, Major M., Jr. Effect of oral hygiene instruction on plaque recurrence following a prophylaxis. I.A.D.R. Abstracts, 1968.

"Paper reviews the motivating factors that have been favorable toward the acceptance of the concept of preventive dentistry by the public. Ideally, motivation for good oral health should be based on: 1) knowledge of what constitutes good health. 2) knowledge of means of maintaining good health, and 3) desire to utilize this knowledge through an appreciation of the significance of health. Specific preventive measures available for prevention of oral disease are: 1) Fluoridation of water. 2) Topical Fluoride, 3) Sound nutrition, 4) carbohydrate restriction. 5) good oral hygiene, 6) therapeutic dentifrice, 7) reduction of trauma (tobacco, mouthguards). Motivation associated with position: 1) Manufacturer concerned with profits, 2) Persons using products concerned with disease prevention, 3) Council on Dental Therapeutics concerned with promoting preventive dentistry to public. Motivation for dental treatment may be result of: 1) Desire for good health, 2) pain, or fear thereof, 3) Cosmetic purposes, 4) Convention, and 5) prepayment programs."

GLASS, Robert L. Motivation for preventive dentistry. J. Dent. Ed. 32:290-295 Sept. 1968.

Three year campaign: - Test Group: 213 boys, 186 girls. Control group 196 boys, 229 girls - all from seven to eleven years old. More improvement in test group (significant at 0.05 level). The change is small considering the effort put into campaign.

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GOOSE, D.H., Goward, P.E., and Downham, D.Y. Oral hygiene campaign in Liverpool. Dent. Practit. 18:385-388, July, 1968.

"To begin treatment with oral hygiene instruction is to plant in the patient's mind the importance of this phase of the entire course of treatment. First things first. It relegates to a secondary role all of the subsequent therapeutic techniques. And, if it is true that all the best dental efforts are doomed to failure in the face of poor home care and lack of patient cooperation, then it is true that the operator's manipulative measures are verily and indeed secondary. One reads in the last chapter of an outstanding textbook under the heading Home Care that 'A patient who has not demonstrated proficiency in home care should not be dismissed.' Perhaps it might have been better had the patient never been started. The next line, however, is of utmost importance, especially in this era of surgical legerdemain, 'on the other hand when the patient is fastidious in his home care, compromised results such as reverse architecture may often be maintained without surgical retreatment.' (text: "Orban's Periodontics") In conclusion, the strongest recommendation to support this concept is that brushing and complete oral hygiene properly executed has never been indicated as harmful. The effect of oral physiotherapy by itself when instituted in the presence of periodontal disease prior to any other therapy will either be negligible, beneficial or detrimental. The last has not been observed in the authors' experience."

GOOTJES, Dirk W., Phillips, Joseph E. and Duffy, John. Oral hygiene instruction before scaling or prophylaxis: a rational procedure. J. Wisconsin St. D. Soc. 46:177-179 May 1970.

"Dental health education programs were developed to create interest and improved oral hygiene through child participation in such activities as: a role-play, a song, brushing demonstrations, discussion of a movie and a story, and joining in the 'Golden toothbrush' contest. Twenty-five primary students participated in the four dental health programs. The children were tested before and after the program series. Data collected was significant. Results showed improvements to be: (+48%) in knowledge and effective brushing, (+28%) in only knowledge, (+40%) in only effective brushing and (+32%) in avoiding bubble gum." (Questionnaires and Song included - seems to be one of the best programs in the literature for young children.)

GREEN, Cornelia. A dental health education program for the primary level. J. Wisconsin S.D. Soc. 47:3-10 Jan. 1971.

Author discusses Suomi's research (see J. Periodont. 42:152-160, Mar. 1971) and concludes with:....."results do not answer the many questions that

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remain before us with respect to the application of what is known about the important role of good oral hygiene in the prevention and control of periodontal disease. The procedures employed in the study to maintain the oral hygiene levels were not intended to be practical. They required a heavy investment of dental manpower to carry out the frequent prophylaxes and for the repeated and concentrated efforts to provide oral hygiene instruction of a quality and quantity that few people are privileged to receive. Even under such optimum conditions, however, the experimental subjects were found upon examination to have some debris, calculus, and gingival inflammation. Thus, one of the major challenges that remains before us, it seems, is how to achieve optimum oral hygiene states in population groups, recognizing the limitations of the dental manpower supply, public indifference and their lack of information about oral hygiene and periodontal disease and the very real difficulties that even apparently well-motivated people have in maintaining optimum levels of oral hygiene." GREENE, J.C. and Vermillion, J.R. The effects of controlled oral hygiene on the human adult periodontium. Int. D.J. 21:8-15 Mar. 1971.

"Paper touches on some determinants of preventive health behavior and some approaches to modifying behavior.....In one nation wide survey, 60 percent of those interviewed believed that 'some people are just born with good teeth and others are not.....and there is not much anyone can do about it.' Another nationwide study found a widely held view that contracting dental disease would not have serious consequences. Persons with such beliefs would not be predisposed to take preventive action even if no obstacles were present.....Face to face communication can be effective in modifying opinions and behavior about health.....However, over 40 percent of those dentists surveyed admitted that they themselves did not attempt to educate patients routinely in their own offices.....An encouraging sign is that more than half the schools reporting to a study indicated that they would like help in improving their dental health education program." HAEFNER, Don P. Achieving public acceptance of preventive dentistry procedures. J. D. Education 32:306-310 Sept. 1968.

"Preliminary investigations of 4,238 Army recruits determined the motivational importance of certain needs, desires and goals and identified blocks to communication between the recruit and the dentist. This study was designed to determine motivational impact of various forms of patient education. 1,769 recruits at four basic training installations were assigned to five balanced study groups. Two groups served as controls and received no patient education. Three groups, experimental, received graduated portions of Army Fresh Start Program. Responses to motivational material were measured in two ways. Each patient's subjective response; change in attitude toward dental health, the Army dentist, or change in position on the decision continuum, was measured by standardized questionnaire. Changes in oral hygiene status were measured by plaque examination conducted prior

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to the education effort and again two months later. It was found that the patient's attitudes had been substantially improved in those groups which had been exposed to the maximum educational effort. While some experimental groups demonstrated reduction in dental plaque scores, reductions were not statistically significant. Two conclusions can be made; population groups can be motivated toward improved oral self-care by educational programs based on behavioral science analysis of motivational factors for that group; and that specific training in effective plaque removal techniques is required to obtain significant changes in oral hygiene status."

HOWARD, R.L.; Cassidy, J.C.; Cassidy, R.J. and Hutchins, D.W. Motivation in prevention. I.A.D.R. Abstracts, 1969.

"Does the dentist require audiovisual aids? Yes, because it is important to motivate patients to intensive home care and to teach them proper technics of oral hygiene. If motivation and instruction are carried out orally during treatment, treatment time is lost. If one uses audiovisual aids, instruction may be moved from the operatory to the waiting room. One gains treatment time and is able to use one's equipment to better advantage. At the same time, the instruction is more interesting to the patient." Article describes the following: 1) picture demonstration at the treatment chair. 2) Audiovisual device in the waiting room. 3) Audiovisual apparatus with manual change of picture. 4) audiovisual device with automatic picture change.

KARDEL, K.M. and Andersen, H.E. Audiovisual aids for motivating and educating patients. Quintessence International J. Dent. 2:69-73 Jan. 1971.

"Detailed history of toothpicks (3500 BC); chewsticks (1600 BC); toothbrushes (1500); dentifrices and mouthwashes (400 BC); floss (1788); stimulators and irrigating devices are relatively new. The failure of public to utilize devices is clearly demonstrated by prevalence of plaque and oral debris. 'The fact that two-thirds of the United States population does not even own a manual bristle brush (Brown, E.L. N.W. Dent. 46:309, 1967) indicates the virtual rejection of this effective, yet relatively inexpensive item'.....Motivational and barrier studies have indicated that an individual will not undertake a health measure unless he feels that the inconvenience encountered by performing this act would be less than the inconvenience he would encounter should he contract the disease.....It would seem virtually any new method or modification of present technics would be helpful whereby satisfactory levels of oral hygiene could be more easily obtained without undue expenditures of patient time or effort."

KIMERY, M.J. and Stallard, R.E. The evolutionary development and contemporary utilization of various oral hygiene procedures. Periodont. Abstracts 16:90-97 Sept. 1968.

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".....primary prevention of periodontal disease.....largely a matter of attention to the details of oral hygiene: Education of patient in the rationale and methods of oral hygiene. Thorough and frequent prophylaxis at recall appointments."

KLAVAN, Bennett Preventive Periodontics. N.Y. State D.J. 34:199-203 Apr. 1968.

Excellent article on motivating patients to personal oral hygiene - for example, the woman patient:..."When teeth are removed there will be a change in the shape of your face. The shape of your mouth and the tilt of your lips will change in direct proportion to the amount of support removed by the loss of teeth. But if you are willing to spend ten minutes of proper home care every day, you can control 99 percent of any dental disease!" (Author describes use of phase microscope also.)

KUHN, Betty Lee. Your role in controlling dental disease. Dental Management 51-71 June 1971.

"The message is: You can keep all your teeth all your life. You don't have to suffer from cavities or bleeding gums.....Those are the claims made by a new kind of preventive dentistry which has gained converts among 15 percent of United States dentists.....Until the 1960's there was no proven treatment for periodontal disease.....The famous fight against tooth decay by fluoridation, special toothpastes and brushing after meals has not been victorious against sugar rich diets and patient apathy.....That is why a new theory and a new technique of dental care has become the rallying cry for a band of crusading dentists. The technique is known as 'plaque control'.....Although the relationship between plaque and disease was known to some dentists 100 years ago, most of the current fervor about plaque control dates from Charles C. Bass, dean emeritus of Tulane University Medical School. Bass wrote that virtually all dental disease is caused by accumulations of microscopic germs on teeth and gums. These germs, which are always present in healthy mouths, mix with saliva to form a transparent, sticky coating called plaque. The tiny, wiggling germs can be seen in a microscopic view of plaque taken from any mouth. They infect the gums and make acids which attack the teeth. Often they are the cause of bad breath.....When it was discovered that plaque takes about 24 hours to build up on clean teeth, a method for preventing dental disease seemed obvious: remove the plaque once a day. Yet that requires a bit of training. Plaque is transparent, hard to see. Brushing usually leaves a lot of it in the mouth, particularly on the sides and backs of the teeth and the borders where teeth meet gums." (Author describes disclosing tablet also)

LANGLEBEN, Tina. The new preventive dentistry. Today's Health 50:33-34, 65-66 Jan. 1972.

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Dr. Latimer describes his own preventive dentistry practice and discusses four main topics. 1) the concepts of prevention that he wants the patient to have. 2) getting these concepts across to the patient and motivating him to follow through. 3) results of this program in terms of success and failure. 4) financial impact on his practice....."My definition of the most successful general practice would be the one in which the greatest percentage of the patients were preventing dental disease in their own mouths because of the influence of the practitioner."

LATIMER, Gerald M. A preventive dentistry program for the general practitioner. Texas D.J. 87:10-19 Dec. 1969.

"Author presents his experiences, observations and ideas concerning his general practice of 'preventive dentistry' during the last eleven years."

LATIMER, Gerald M. Thoughts on prevention. Texas D.J. 89:12-17 Dec. 1971.

Article describes puppet show for elementary students and includes script on "talking teeth". The script covers home care habits, diet, functions of the teeth and routine dental visits.

LeClair, Virginia. Welcome to a smile-in. J.A.D. Hygienists' Assn. 45:44-46 Jan.-Feb. 1971.

"Eighty-four adult patients from lower socio-economic stratum examined initially and at intervals of 30 and 180 days following completion of treatment. Pocket depth and indices for plaque, calculus and gingivitis were recorded. A dental knowledge test was given at each examination. Patients divided into two groups by random. Control group received an oral prophylaxis and topical fluoride application. Experimental group received a dental education package in addition to the treatment given control group. Experimental group exhibited significantly increased levels of dental knowledge as compared to the control group at both 30 and 180 day testing intervals. Forgetting was not observed during the 30 and 180 day interval.....Mean plaque, calculus and gingivitis scores were significantly reduced in the experimental group at 30 days post-treatment as compared to values recorded in control group. By 180 days post-treatment oral health indices in both groups tended to return to baseline levels.....It was concluded the individualized patient education can result in successful transfer of information to adults with the expectation of long-term retention. Patient motivation as reflected in improvement of oral health indices, can be successful but results may be of more limited duration. This suggests that reinforcement of aspects of patient education dealing with patient performance should be conducted at appropriate intervals."

LEGLER, Donald W.; Gilmore, Ralph W. and Stuart, Gina C. Dental Education of disadvantaged adult patients: effects on dental knowledge and oral health. J. Periodont. 42:565-570 Sept. 1971.

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Question: What is your solution to the problem of motivating patients to take better care of their mouths via home care procedures? "In motivating patients I try not to ask the impossible of them. I evaluate what I think they really do in the line of home care through observation and conversation. I point out what improvement could be made with a little effort and let them draw a conclusion of what more effort could produce.....In short, education, understanding, and good personal rapport are the keys to effective patient motivation..... Let patient see his present brushing habit is not adequate through use of disclosing wafer. Individualize the home care routine to suit the needs of each patient, and make him aware of this fact. Try to teach something new at each session as patients cannot absorb too much new material at one time. Finally, any improvement in hygiene should be encouraged with praise."

LEVIN, Arlene How I do it J. Am. Dental Hygienists' Assoc. 42:89-91 2nd Qtr. 1968 (compiled and edited by Arlene Levin Associate Editor)

"To secure information on how best to treat its personnel, the United States Air Force initiated a study of preventive periodontic technics at the U.S.A.F. Academy in July 1965. This paper reports on the findings of that study over the entire 46 month period.....470 young males participated and completed study of the effectiveness of various schedules of preventive periodontic treatments and the teaching of toothbrushing. There was a steady improvement in gingival health for all participants over the first two years. Each treatment group appeared to reach a plateau after this two year period with little or no difference between each groups' mean value for the last two examinations. Group 4A receiving the most intensive preventive care and instructions in toothbrushing showed significantly more improvement than groups receiving less care. Groups 3 and 4A which received the largest number of preventive treatments with instruction in toothbrushing had the lowest percentage of men affected by loss of epithelial attachment. There were no significant changes in periodontal index scores for any of the treatment groups over the study period. Groups receiving instruction in toothbrushing (2, 3, 4A) showed significantly larger decreases (improvement) in plaque scores than Groups 1 and 4B which did not receive instruction. Hard deposit scores decreased for all groups over the study period. Group 1 which received the smallest number of preventive treatments with no instruction in brushing showed significantly less improvement than the other treatment groups.....The treatment given to cadets in Group 4A proved to be the most effective, statistically, although the improvement over Groups 2 and 3 was not clinically dramatic. If the problems encountered in treating a large population are considered it would seem that the preventive regimen given to Group 2 (one treatment per year given in two 30 minute appointments with toothbrushing instruction) would be both practical and effective."

LIGHTNER, Lee M. Preventive periodontic treatment procedures: results over 46 months. J. Periodont. 42:555-561 Sept. 1971.

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"The aim of the investigation was to determine whether careful training in toothbrushing had a prolonged effect on the oral hygiene and gingivae of 13 to 14 year old school-children. Supervised toothbrushing had continued for three years and ended one year before final gingival and plaque scorings were carried out.....Results clearly show that toothbrushing program had marked effect on oral hygiene and gingival conditions during the experimental period. It had no prolonged effect on oral hygiene of children.....No attempt was made to explain to the children why they should apply the particular brushing technique, nor were they asked to continue the oral hygiene by regular home care. The consequence of this was perhaps they brushed only at the procedures at school. Then when the three year experiment ended, they had not gotten into the habit of using toothbrush and dentifrice at home."

LINDHE, Jan and Koch, Göran The effect of supervised oral hygiene on the gingivae of children. J. Periodont. Res. 2:215-220, 1967.

"The secret of success in teaching effective oral hygiene is to establish a routine pattern to be rigorously followed. Patients are taught to begin their brushing on the maxillary buccal surfaces of the right and proceed to the maxillary left. The buccal surfaces of the mandible are then brushed proceeding from left to right. The lingual surfaces of the maxilla and mandible are now brushed in the same order from right to left and left to right. Brushing is followed by the use of unwaxed dental floss for cleaning the interproximal spaces. This exercise is not only demonstrated for each patient with the aid of a mirror, but they have the opportunity to practice the proper and adequate use of dental floss under supervision. One of the most important parts of this program is self-evaluation of the effectiveness of brushing. For this purpose the patient is taught how to use either disclosing tablets or solutions."

LOBENE, Ralph R. How to motivate patients toward effective and permanent oral health. Parodontologie 25:58-59 June 1971.

"As caries control improves, periodontal disease must be more clearly highlighted as a major problem. Anything less than a revolution in the organization of dental services and in the dental students' curriculum fails to tackle the problem."

MANSON, J.D. Periodontal disease as a social problem. Refuat Hashin 17:(1-2):34-42 Apr. 1968. (Abstracted in Advances in Periodontics 1:81 1970 by T. Dishon.)

"Detailed practical proposals are put forward to show how prevention of dental caries combined with planned treatment could result in the control of this disease among school children, within a reasonable length of time



and in an economic manner. It is based on a ratio of 1,700 children to each dental officer and on the average state of dental health in British children. It is stressed that planning must be based on local information because of the many variables involved. A new criterion of effective dental treatment is required and it is proposed that this should be the reduction in the amount of untreated dental disease. Prevention is of first importance and can be used to greatest effect in the public dental services. If full use is made of proven preventive methods, the capacity of the dentist to control dental disease could be greatly expanded, provided that treatment is adequately planned. The dental team should be expanded to include a hygienist who will use preventive measures to reduce dental caries (topical fluoride) and will educate children in dental health. Estimates of the cost of employing a hygienist are made. If these are accurate then these proposals are more economic than the present line of development with the public dental service if measured in terms of proposed criterion of dental health."

McKENDRICK, A.J.W. Control of dental caries by the school dental service. The application of preventive treatment and incremental care. Brit. D.J. 128:185-193 Feb. 3, 1970.

This article describes in detail the organization of a "brush-in" program in the schools and summarizes with....."Perhaps, most important of all, there is the instructional aspect of the program which is based upon "doing" and "participating" rather than upon a passive form of instruction." (results of brush-in not given.)

MERCER, Victor H. and Kelley, Gordon E. The Indianapolis "brush-in" - a meaningful experience in dental health. J. Ind. Dent. Assn. 49:421-425 Nov. 1970.

"A type of programmed instruction composed of a series of color slides and a tape recorded dialogue on general concepts of oral health was presented to 15 subjects. By use of a pre-test and post-test, the amount of learning in these subjects was compared with learning of 15 clinic patients who received conventional chairside education. The experimental group scored significantly higher than the control group; however, further study is needed to determine the effectiveness of this device in improving dental health of patients."

MINNICH, Wanda and Latimer, Laura. Dental health education methods - a comparison of their effectiveness. J. Am. D. Hygienists' Assn. 44:40-45 1st Qtr. 1970.

Author discusses the advantages of patient mailings which include: "..... regular mailings keep dentistry in the patient's mind.....patients

appreciate the effort. They're used to monthly bills. But now the doctor is mailing something more - just because he cares about their health and wellbeing."

MITTLEMAN, Jerome S. Reaching patients where they live. Dental Management 83-93 June 1971.

"The more one teaches, the more enthusiastic one can become about such teaching. Not a small value to any dental practice would be to have the entire office staff so believing in their teachings to patients that they themselves would practice what they preach."

MORRISON, G. Archanna Values of patient dental education. Arizona D.J. 15:10-17 Feb. 1969.

"The biggest gap between those who believe future dental practice must be predominately preventive oriented and dentists who have been saving their patients' natural dentitions for years through good operative procedures and a reasonable emphasis on home care, is that the latter are unable to understand how a professional - a doctor with eight or more years of university training - can be satisfied to make a career out of teaching people how to clean their teeth."

MOSTELLER, John H. Telling it like it is....preventive dentistry: big deal or old hat. J. Ala. Dent. Assn. 55:15-17 Oct. 1971.

"A program of dental education was developed which includes the use of a Dental I.Q. test for measuring the child's dental knowledge, a dental health education textbook to be given to patients for home reading, and a clinical examination for estimating oral debris and gingival health. The use of three techniques in a clinical study showed that dental health education reduced the amount of debris present, improved the oral hygiene index, and reduced the amount of periodontal disease." The study consisted of five classes, 30 students each, ages 15 to 18. After I.Q. and initial examination, six weeks of lecture series - three months later students were re-examined by original examiner and again took Dental I.Q. test.

MUHLER, Joseph C. Practical chairside dental health education. J.D. Child. 33:215-218 July, 1966.

...."In summary, it seems that the motivational methods being used may be adequate, but that the way they are used may need more consideration. Before starting to educate a prospective dental patient, perhaps we should try to understand what the patient thinks about his dental health. In this way try to determine the starting level of his dental education, as well as his ability to obtain needed dental care, and thus to motivate

him slowly. When using persuasion, show empathy, involvement and a real interest in the patient's oral health. Often the image of dentistry may be damaged when the dentists do not show enough interest in emergency or very minor dental treatment when in the mind of the uneducated or unappreciative patient, it is the most important thing at the moment. The dentist should remember that his own knowledge of and appreciation for dental care has developed not in one day, week or month, but over a period of years of intensive education."

NEEDHAM, P.L. Motivating a patient toward better oral health. J. Missouri D. Assn. 49:25-26 June-July, 1969.

"Motivation is a continuing process. It begins when the patient is first seen, continues during active treatment, and as long as the patient receives routine preventive care. The objective of oral hygiene procedures is to clean the teeth without causing damage. The minimum procedures to accomplish this are prescribed. The patient who has shown little past interest in dental care and oral hygiene can be overwhelmed by being immediately introduced to several hygiene procedures. It is usually best to begin by instructing this patient in brushing only. Attempting to introduce all necessary cleaning procedures at one time can invite failure. The patient may listen quietly as techniques are described and demonstrated but inwardly decide that there is no possibility of learning and successfully carrying out all of these procedures.....The clinician's role is to establish the importance of bacterial plaque, develop the need for oral hygiene procedures, and to set forth desirable future goals that the patient can achieve."

O'LEARY, Timothy J. How patients are motivated and taught to practice effective oral hygiene. J. Western Soc. Periodont. 16:98-99 Sept. 1968.

"In 1979 the criteria of various disease entities will be identified and the etiology of the infective microorganisms understood. The potential of each child's jawbone will be understood, corrected and developed starting at an early age. A three dimensional function consideration will be given to all concepts of occlusion. Payment for services will be based on prevention and correction by therapies to prevent infection. Restorations and replacements will be valued as auxiliary services. Standards of oral health will not be based on white teeth and cavities, but on the values of healthy mouth tissues. Oral health care will be guided by responsible professional advice for preventive treatment."

PETERSON, C.T. Mouth care 1979. Pakistan Dental Review XX:32-36 Jan. 1970.

Article presents a method of educating patients in the dental office. The main set of objectives for getting patients informed about dental caries, periodontal disease and oral cancer are outlined.

PODSHADLEY, Arlon G. The essential elements in educating patients. J. Public Health Dentistry 28:249-255 Fall issue, 1968.

"Summary: An investigation has been conducted for comparing the effectiveness of teaching two groups of eight to ten year old children different methods of toothbrushing. One group was taught to brush 'as teeth grow', and the second to use the 'random' method, the third served as the controls who did not participate in the program. The Patient Hygiene Performance (PHP) method was used to determine effectiveness.....An initial PHP score was calculated for each child and additional PHP scores were calculated at two weeks and at four months after the education presentation. The results of this investigation reveal no significant difference in oral hygiene between the controls or either of the study groups. One may conclude therefore that neither of the two methods taught by a single lecture on concepts of dental health and a demonstration of toothbrushing is effective in changing the performance of eight to ten year old children."

PODSHADLEY, Arlon G. and Schweikle, Edith S. The effectiveness of two educational programs in changing the performance of oral hygiene by elementary school children. J. Public Health Dent. 30:17-20 Winter Issue, 1970.

"A single lecture presentation followed by a toothbrushing demonstration is commonly used to teach elementary school children the importance of good oral hygiene. This investigation was conducted to determine the effectiveness of such a program in changing the oral hygiene behavior of ten to twelve year old children.....The only difference in the mean scores which would indicate a greater improvement in oral hygiene in the study group occurred at the two week examination period. The control group improved by 0.35, and the study group by 0.76. Although the difference of 0.41 indicates a slightly greater improvement in the study group, the magnitude of this difference is too small to be of clinical significance in the prevention of dental disease.....The results indicate that it would be advisable to design a more comprehensive approach for teaching the importance of and method of achieving good oral hygiene and subsequently, to test the effectiveness of such a program."

PODSHADLEY, Arlon G. Oral hygiene performance of elementary school children following dental health education. J. Dent. Child. XXXVII: 298-302 July-Aug. 1970.

Author discussing Loe et al, 1965: "Withdrawal of oral hygiene procedures resulted in the accumulation of dental plaque and the clinical appearance of chronic gingivitis within ten to 21 days. Concurrent sampling of the forming plaque from the gingival crevice area demonstrated interesting changes in the population of the deposits. At first(one day) it consisted of a sparse flora with largely gram positive cocci. During the second and third day gram negative cocci and rods appeared but the complete character of mature plaque was not established until seven to ten days. Reintroduction of oral hygiene procedures resulted in a rapid disappearance

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of deposits and a rather slower disappearance of gingival inflammation....  
 ..The most important factor is obviously the motivation of the patient.  
 (for removal of plaque) It is all too clear that most regular users of a  
 toothbrush have no idea what they are trying to achieve. Most consider  
 it to be a socially desirable habit and little more. It is important  
 therefore to demonstrate to the patient what plaque is, how it forms and  
 how it produces disease. Understanding enables patients to undertake a  
 logical regimen of oral hygiene with some enthusiasm. Instruction in  
 technique is important but it must be remembered that a variety of brush-  
 ing techniques may be required and that the method must be tailored to  
 the individual requirement of the patients. Teaching should be carried  
 out in the patient's mouth with a hand mirror and using a disclosing  
 solution, to enable the patient to understand every phase of his hygiene  
 procedures. Plaster models are far less satisfactory and are completely  
 unfamiliar to patient."

POWELL, R.N. Oral hygiene and the dental plaque. J. Irish Dent. Assn.  
 16:167-171 Nov.-Dec. 1970.

"The communications media are teaching your patients that preventive dentistry is the best dentistry. Dentistry is changing. Within the next five to ten years the whole character of dental practice will be so different that if we were to place 1960's average practitioner in a time capsule set for 1975, just 15 years later, he would not recognize the dentistry performed in his own office. No longer will there be 'fill and pull' dentists, if indeed some still exist. Rather, the entire practice of dentistry will be prevention-oriented.....The same thinking applies to buying a luxury automobile. To justify the higher price tag, the salesman need only explain that the 'air-conditioning and power features' are standard equipment in the particular make. I intend to practice this style of dentistry and give my patients all of the extras at their recall appointment.....You know how to prevent dental problems in your mouth, Doctor. Do your patients deserve any less?.....You are in danger of losing many of your best patients - those who are intelligent, financially reliable, cooperative. They talk about dentistry with their friends and will leave your practice if they hear of a more effective treatment than that offered by your office. They are the patients who will be unhappy if you or your hygienist has not advised them about the proper use of the toothbrush and dental floss, or if you have not incorporated dietary counsel and fluoride applications for their children in your routine treatments. In short, if you are not practicing modern preventive dentistry, Doctor, your practice will suffer."....

ROBBINS, Martin B. Preventive dentistry is a practice builder. Dental Economics 60:23-25 Mar. 1970.

"This article on preventive dentistry is not intended to describe specific techniques for oral hygiene. Rather its purpose is to explain one approach

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to introducing new patients to preventive dentistry concepts."

ROSSI, Richard E. Introducing your patients to preventive dentistry. Northwest Dentistry 50:221-225 May-June 1971.

".....One successful education program of this type was developed by Dr. Robert F. Barkley based on research by Dr. C.C. Bass and Dr. Sumter Arnim. I have found this technique easily adaptable to the dental school clinic and the response has been excellent - virtually 100 percent favorable.....The goal of this program is to enable the patient to understand his dental disease condition and the microorganisms that cause it.... Further studies showed that a very fine, unwaxed nylon dental floss was most effective in cleansing these areas with the least trauma. After these microorganisms were removed, it took them approximately 24 hours to reorganize. Therefore, one can disorganize the bacteria in his mouth once a day, rendering them ineffective.....However, as Dr. Arnim found, it is not the organized microorganisms per se that directly cause disease. Rather, it is their waste products in contact with the gingivae....Both the tissue fluids and the epithelial cells are food for the bacteria. A vicious cycle is thus established....."

RUNNELS, P. R. III. Education of the public in dental health. Dental Student 48:86-88 June 1970.

"A state-wide program of dental health education, designed jointly by the School of Dentistry and the cooperational extension service of the Appalachian Center, has been described. The organizational detail and a number of teaching guides have been presented."

SALERNO, Fred R. and Bennett, Carroll G. Dental health education for all West Virginians, 1) Its organization. J. Public Health Dentistry 28:173-181 Summer Issue 1968.

Author's purpose is to show how printed materials, particularly those produced by the American Dental Association, can be used to educate dental patients. Situations that occur in dental offices every day are examined and the appropriate booklets are listed by titles.

SANDELL, Perry J. Printed material in patient education. J. Ontario D.A. 45:367-369 Sept. 1968.

"By refusing to treat patients lacking the necessary motivation in oral hygiene at the initial stages, we reduce the number of failures and will have more time for those patients who proved to us by their interest and cooperation that they will be worth the time and efforts needed for the

complex treatments in periodontal prosthesis."

SCHARER, Peter. Patient motivation in periodontal prosthesis. Parodontologie 25:60 June 1971.

"Total of 256 subjects (Navy enlisted personnel in submarine course) were paired on the basis of debris and were assigned to test and control groups. Eight different hygiene motivation programs were presented to subjects. 1) Navy training Film: "Preventive Dentistry - Patient Responsibility, 2) Navy training Film: "Oral Hygiene", 3) Subjects tried wafer staining technique. 4) Detailed instructions on correct way to brush. 5) Combination of three and four. 6) Fifteen minute lecture - hygiene as self-preventive treatment. 7) combination of six and one (30 minutes), 8) combination of six, four, three, one (70 minutes). Analysis revealed no benefit from any of the motivation programs from standpoint of debris reduction or increased tooth-brushing frequency."

SHILLER, William R. and Dittmer, John C. An evaluation of some current oral hygiene motivation methods. J. Periodont. 39:83-85 Mar. 1968.

"The family's role in producing and maintaining dental health practices, values and attitudes was investigated in a suburban community of 52,362 persons.....Mothers were found to be both guardians and teachers of oral hygiene practices, yet authoritative information on oral care reached fewer than one in five prior to child's school years. Conclusions: Norms for dental care are changing, but education of the public is needed regarding periodontal disease and preventive dentistry. The school via children may provide effective communication between families and profession."

SIGNORILE, V.; Rayner, J.; and Richards, L. Dental hygiene in the family setting. I.A.D.R. Abstracts 1968.

"Clinical study to determine if an intensive course of dental health instruction would significantly improve oral hygiene of group of elementary school children.....fourth and fifth and sixth grade students on two Indian reservations. Results indicate level of knowledge of oral health can be improved significantly through dental health education, but attitudes about oral hygiene and the practice of oral health principles are changed very little. The score for debris of the study group deteriorated 4.6 percent while that of the controls improved 8 percent. The intensive dental health education program for the study group effected a 17.8 to 38 percent improvement in the level of knowledge over that of the controls, but the study group had lower initial scores. The individuals attitude toward his own oral health did not improve and, in fact, the mean scores decreased 17.8 percent and seven percent in the study-group and controls, respectively.....Factors other than teaching and audiovisual aids exert greater influence on changes in concern for dental health. Insight must

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be gained, hence, about dental attitudes and the factors which influence the acceptance or rejection of dental health education before dental health education can change significantly the habits that affect the practice of oral hygiene.....1) an improvement in oral hygiene occurs during the school year with instruction in oral health, but this improvement is not retained. 2) intensive instruction in dental health significantly improves the level of knowledge of oral health, but appears not to be significantly better than that of the instruction by graded textbooks in the classrooms."

STROLPE, John R.; Mecklenburg, Robert E. and Lathrop, Robert L. The effectiveness of an educational program on oral health in schools for improving the application of knowledge. J. Public Health Dent. 31:48-59 Winter Issue, 1971.

"In summary, oral neglect can be a behavioral process that is unconsciously determined, is not readily subject to change, and suggests a diagnosis of chronic depression."

SWORD, Richard O. Oral neglect - why? J.A.D.A. 80:1327-1330 June 1970.

"I emphasize that unlike almost all other surgery, the maintained success of periodontal surgery depends largely upon the standard of cleaning achieved by themselves."

WADE, A. Bryan. How do I motivate my patients towards good and permanent oral hygiene? Parodontologie 25:26-57 June 1971.

"Last year the parents of 150,000 Indiana school children responded to the challenge of reducing dental decay by giving written consent for their children to participate in a school self-application program. These children were given this opportunity to improve their oral health because someone in their community cared enough to spend time, energy and talent in organizing a 'brush-in'.".....This article does not mention results, just steps to organize, such as dental society approval, school approval, financing, supplies, inservice training schedule, consent forms, publicity, organization of supplies, operation brush-in, and follow-up.

WANN, Mary A. Get the brush rolling. J. Ind. Dent. Assoc. 49:431-433 Nov. 1970.

"Dental caries and periodontal disease can be prevented when patients understand their nature and when they are motivated to practice an effective oral hygiene program directed toward the removal of the causes of their dental ills. The facts dentists and patients should know are dis-



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cussed, clinical procedures outlined step by step, case reports demonstrating arrestment, control and restoration of mouths with rampant caries and periodontal disease are presented."

WHEATCROFT, Merrill G. and Arnim, Sumter S. An effective program of oral hygiene the dentist can teach adolescents. Dental Clinics of No. America 13:375-386 Apr. 1969.

"One hundred eighty-three high school students were given six lectures on dental education and were compared with control subjects to see whether a dentist could motivate students to improve their oral hygiene through dental education. The findings after three and six months indicated the study group showed significant improvements in the oral debris, calculus, oral hygiene index score, periodontal index, toothbrushing frequency and in dental I.Q. score."

WILLIFORD, John W.; Muhler, Joseph C. and Stookey, George K. Study demonstrating improved oral health through education. J.A.D.A. 75:896-902 Oct. 1967.

"Unless the patient is suffering the discomfort of a toothache and is in pain, there is no big need to get all excited and immediately get them in the chair and get your hands in their mouth to repair the diseased tooth. The patient should - first - be educated as to what the situation is - why it exists and what is involved in solving the problem; and what he can do to prevent the problem from occurring again - 'inform before you perform'.".....Author suggests dentists hire girl as "dental educator" to explain therapy, teach brushing, flossing, water rinses, fluorides, etc., or use film and slides....

WOLFF, Roy M. Preventive dentistry through patient education. J. Tenn. State Dent. Assoc. 50:217-220 Oct. 1970.

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(Article describes author's private practice of preventive dentistry and includes:). . . . "The patient's teeth are stained with a vegetable dye to show him how much cleaning has to be done. The dye also makes it easier for him to see what he has accomplished. We employ the Bass technique (bristles pointed toward the gum line and gentle brushing in a small circle) with Bass style brushes and unwaxed dental floss. A regular flashlight is provided for the patient to check the results as this is what he will have available to him at home. To encourage continued use of the proper materials, each patient receives printed lists of the type of paste, brushes, floss I prefer. Starter supplies are given each new patient and we invite them to return to our office for additional supplies."

ANDERSON, Jack L. An acre of diamonds. Practice Administration 6:13-15, Summer 1969.

Author describes methods of using 0.02 percent aqueous methyl red solution to demonstrate acid production by mouth bacteria. Method: Show patient plaque on any tooth surface - scrape enough to form a circle 1/4 inch size - place two to three drops a-m-r on ring of plaque, add a few crystals of sugar to center of ring. Patients with ability to form acid quickly provide a bacterial mass that will turn the indicator red within a matter of seconds. Patients soon learn that sugar left on teeth turns into red acid. . . . The effectiveness of hygienic practices is readily shown when patients learn to clean their mouths thoroughly. Plaque becomes scarce and it is seldom acid on removal from mouth of child with thorough hygienic habits. Emphasis must be placed on floss and brush (Bass technique), rinsing thoroughly and substituting natural foods for highly refined sugars and flours.

ARNIN, Sumter S. and Hardwick, J.L. Clinical demonstrations of acid production by mouth organisms using aqueous methyl red. North-West Dentistry 33:147-154 May 1954.

"As W. D. Miller and others demonstrated the great variety of lesions that could be produced by the use of abrasive dentifrices, the term "dentifrice abrasion" came into general usage to denote the condition. It is used in this report to designate the progressive wearing away of hard tooth substance in the cervical area as the result of regular, vigorous, forceful use of an extra hard, natural bristle brush with generous amounts of toothpaste."

ARNIM, Sumter S. and Blackburn, Estes M. Dentifrice abrasion - report of a case. J. Periodont. 32:43-48 Jan. 1961.

"Methods are presented for using disclosing agents to measure tooth cleanliness. A palatable food color tablet of F.D.C. Red #3 (erythrosin) is

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recommended as the dye of choice. Results obtained by using disclosing agents to evaluate a variety of hygiene practices are illustrated. The use of these methods for teaching personal oral hygiene and prevention of dental disease is discussed."

ARNIM, Sumter S. The use of disclosing agents for measuring tooth cleanliness. J. Periodont. 34:227-245 May 1963.

Article prepared for patients, plainly written, well illustrated. "For your convenience, the harmless food color dye F.D.C. Red #3 has been put in a candy-like wafer that may be chewed and swallowed. The dye will stain the invisible clumps of germs sticking to your teeth that cause you trouble. You will be able to see them plainly in a mirror. Now that you can see them, it is easy to clean them off with a soft bristle toothbrush, (Hard bristles may scratch gums). It is a good idea to clean first with brush and water only - this allows you to see exactly what you are doing - next clean in between teeth with dental floss. It is passed gently between the teeth and underneath the edge of the gum. Then it is held tightly against the approximal surface toward the chewing edge of the tooth. Each approximal surface is cleansed in this manner."

ARNIM, Sumter S., Diercks, Clinton C. and Pearson, E.A., Jr. What you need to know and do to prevent dental caries and periodontal disease. J. No. Carolina Dent. Soc. 46:296-305 Aug. 1963.

"This work of Bass and Arnim is the greatest single contribution to the dental health of humanity in this century.....Dentists by the thousands will put out the real effort that it takes to alter the way they practice; but there will be thousands more who still remain dental repairmen, and patients quickly learn to tell the difference." (Article is a history of Bass and his research, especially mouth bacteria and his process of cleaning with unwaxed floss and rounded bristle brush.)

BARKLEY, Robert F. Mississippi Farm Boy Goes Big Time. J. Miss. D. Asso. 24:147-151, 175, 184 Oct. 1968.

"He (Bass) found that to be harmful, bacteria had to grow on something hard like a filling or the underside of a replacement tooth or calculus. ....an excellent job of brushing cleaned perhaps 90 percent, but that the 10 percent missed beneath the gums was the location of most dental disease. Studies revealed a very sharp, highly refined unwaxed nylon floss seemed best to handle problem areas with least amount of trauma. When these bacteria were removed, it took 24 hours to reorganize in any quantity. It immediately became apparent that you could disorganize the bacteria in your mouth once a day and render them harmless." (This is a detailed account of one patient's periodontal problem and Dr. Barkley's office procedure in teaching hygiene technique. Doctors Arnim and Bass are quoted)

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BARKLEY, Robert F. Unshackle your patients. Tenn. St. Dent. Assn.  
49:25-30, Jan. 1969.

"Almost all loss of teeth results from either caries or periodontoclasia. These two diseases can be prevented by the necessary personal oral hygiene. They cannot be prevented in any other way now known. The purpose of this paper is to present the oral hygiene procedure every person must follow in order to entirely prevent these diseases and their consequences, and in order to maintain the state of oral cleanliness most people would like to maintain.....To prevent the occurrence and progress of the lesions of these diseases (caries and periodontoclasia) their early stage must be prevented. The oral hygiene necessary to prevent these diseases, therefore, must effectively meet and counteract the etiological conditions at the location where the lesions originate.....Enamel caries begins principally at or about occlusal pits and fissures and at or about the contact area between the teeth. The earliest lesion consists of a 'white spot' or 'chalky' partially decalcified enamel. If the conditions are prolonged, the lesion extends in area and depth and finally this fragile, partially decalcified enamel breaks down producing a cavity - the advanced stage of caries.....You must clean your teeth right with the right kinds of both toothbrush and dental floss every night before retiring.....If the teeth are also cleaned partially or well at other times, this contributes to greater oral cleanliness, but under no circumstances may such cleaning at other times of the day take the place of the essential cleaning at night before retiring.....(Author gives specifications for the right kind of toothbrush and describes brushing and flossing in detail. Floss specifications in Dent. Items Int. 70: Sept. 1948) (Author suggests toilet soap on brush to help clean teeth and ordinary prepared chalk to remove stains. No dentifrices necessary.) Results - The author has instructed and had under observation, a sufficient number of subjects to be able to state positively the beneficial effects that result from the personal oral hygiene herein specified: 1) no new caries lesions develop. 2) early stages of lesions do not progress further or break down (white spot). 3) cavities do not progress - usually become inactive. 4) correctly made fillings do not break down. 5) no new periodontoclasia lesions occur. 6) all early stage periodontoclasia lesions heal promptly - it is almost dramatic the way in which the bleeding from the gingival crevices stops entirely after the first few days. 7) each advanced stage periodontoclasia lesion and deep pyorrhea pocket is a separate problem.....the beneficial results will depend largely upon the extent of the lesion and the damage already done. In favorable instances suppuration and inflammation of periodontal tissues subside, and loose drifting teeth usually stabilize. 8) foul odor from food material is avoided. 9) satisfaction is derived from the sense of oral cleanliness which one enjoys.....It is evident that the practicing dentist should teach the necessary personal oral hygiene to his own patients....Until he learns and practices the necessary personal oral hygiene to save his own teeth, he is not very well prepared to instruct his patients how to save theirs."

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BASS, Charles C. The necessary personal oral hygiene for prevention of caries and periodontoclasia. New Orleans Med. & Surg. J. 101:52-70, Aug. 1948.

"Attention has been directed to the essential local etiological conditions in caries and in periodontal disease. The lesions of these diseases are caused, and their advancement is promoted, by uncleanness at vulnerable locations on the teeth which are not naturally kept clean .....Caries activity, and to a large extent, periodontoclasia activity, occur at night during quiet and sleep. To prevent them the teeth must be thoroughly cleaned at night before retiring thereby securing a long period during which there is no food material about the teeth to ferment or decompose, and relatively little growth of harmful bacteria takes place....The teeth can be effectively cleared at the important locations only by the proper application of the bristles of an appropriate toothbrush and the filaments of the right kind of dental floss. Details of the method are given. These differ from and in some particulars are the opposite of those usually followed. To maintain a high degree of oral cleanliness, and to prevent caries and periodontoclasia, the teeth must be cleaned right, with the right kind of both toothbrush and dental floss, every night before retiring..."

BASS, Charles C.....An effective method of personal oral hygiene. J. La. St. Med. Soc. 106:57-73, Feb. 1954 and continued in Mar. 1954, 106:100-112.

"Brushing tests performed on total of 73 persons - 20 male and 53 female students, using the vertical one-way rotating and the horizontal reciprocating brushing techniques. Analysis of graphs revealed that a fundamental difference in the contact relation, brush/tooth surface, existed between vertical and horizontal toothbrushing techniques. Horizontal brushing gave rise to a prolonged contact duration between bristles and tooth surface as compared with vertical brushing. This fact may explain the earlier observation that horizontal brushing produced more dentine wear than did vertical brushing."

BJORN, H.; Lindhe, J. On the mechanics of toothbrushing. Odont. Rev. 17:9-16, 1966.

(An effective photographic technique is briefly described and illustrated.)  
...."An oral hygienist cleans and polishes the teeth to provide a reference level of 'clean teeth'...This condition is photographed immediately. Photography is continued at frequent and regular intervals for weeks or months.....assessment to be made on a basis of 'before' and 'after' comparisons."

CALLENDER, R.M. The assessment of tooth cleanliness. Med. Biol. Illus. 18:193-194, July 1968.

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"1) The bacterial plaque attached to the tooth must be regarded as an important factor in periodontal disease. 2) The easy removal of plaques by the patient's home care efforts is of prime importance in the prevention of the recurrence of pockets. 3) Smooth tooth surfaces as well as minimal crevice depth and good gingival architecture are major objectives of treatment. 4) Root planing or the smoothing of the hard tissue wall of the pocket enables this objective to be achieved."

CHACE, Richard Methods and values of tooth planing in periodontal therapy. J. Periodont. 32:233-236, July 1961.

(Good illustrations showing how to hold and use dental floss, how to brush using Bass technique, and the type of brush necessary, i.e., rounded, polished and satinized ends to the bristles)".....Causes of tooth loss: 80 percent periodontal disease; 20 percent all other dental problems.....(Article describes oral hygiene kit given to patients: bacterial plaque disclosing wafers, magnifying mouth mirror, a magnifying mirror that fits onto an ordinary flashlight, dental floss, toothbrushes).....When instructing a patient in the control of periodontal disease, there are three areas that need emphasis: 1) Between the teeth. These areas should be cleaned with dental floss. This is where the greatest occurrence of caries and periodontal disease is found. 2) The outer and inner surfaces of the teeth. These areas should be cleaned with the toothbrush. 3) The space where the teeth and gums meet. These areas can be cleaned efficiently with a water spray device and are where bacteria concentrate." (Authors recommend film strip to demonstrate correct oral hygiene. They use Master's "JUST 15 MINUTES A DAY".)  
CORN, Herman and Marks, Manuel H. The role of the dental assistant in oral hygiene instruction. The Dental Assistant 38:12-18, Oct. 1969.

"My own personal choice for greatest success in periodontal and caries control is the toothbrush with the soft nylon rounded bristle tips used at a 45 degree angle to the long axis of the teeth and directed at the gingival sulci. Bristle tips are rotated in the smallest circle possible in a very slow, pivotal manner without removing tips from gingival crevice.....(Author recommends nonwaxed dental floss, use of mirrors and phase contrast microscope to let patients observe living germs.)....The true oral health potential of a patient may be the result of his home oral hygiene education." (Author refers to Arnim and Bass articles.)  
DETAMORE, Lt. Col. Robert J. While the bacterial plaque adheres. Chronicle of the Omaha Dist. Dent. Soc. 32:56-57, Oct. 1968.

"Eleven patients with periodontal disease were placed on a strict oral physiotherapy regime employing an irrigating spray, tooth brushing (modified Stillman Technique) and waxed dental floss for a period of six months without prior scaling or other periodontal treatment. After six

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months, each patient had half of the mouth scaled and the oral hygiene program continued for an additional three months. The periodontal condition of these patients was evaluated on the basis of clinical and radiographic appearance, pocket depth, and microbial mass indices. Color clinical photographs, study models and biopsies were obtained on all patients at the beginning, at six months and at the conclusion of the experimental period of nine months. The water irrigating spray is an important adjunct to oral physiotherapy since it removed most of the microbial mass with resultant improvement in gingival color, density and anatomy, and reduction in periodontal pocket depth. The change induced in the microbial mass index and specifically, the motility of the mass, was directly related to the improvement noted in the periodontal condition. The use of the microbial mass index is of value as a measurement of disease in periodontally-involved tissues and together with the disclosing wafer is an excellent patient education tool."

DUNKIN, R.T. A new approach to oral physiotherapy with a new index of evaluation. J. Perio. 36:315-321, July-Aug. 1965.

Six objectives of oral hygiene procedures assessed: 1) Diluting and washing away solutions and loose debris. 2) Removal of materia alba, food material, plaque and calculus. 3) Reshaping the gingival contour. 4) Massage of the gingiva. 5) Whitening of teeth. 6) Increasing resistance to caries. "....Results confirm Arnim's findings that artificial oral hygiene can be far more effective than natural methods. The chewing of detergent foods cleans the occlusal surfaces quite effectively and most of the palatal in the upper jaw and buccal surfaces in the lower, but does not clean the gingival third of these surfaces....Mouth rinsing, even with the Weissenfluh mouth irrigation plant, did not remove bacterial plaque from the teeth....its importance in chronic periodontal disease is difficult to determine. Mouth rinsing immediately after ingestion of sticky carbohydrates is probably of value in prevention of dental caries.....The proven value of oral hygiene is in the prevention and treatment of periodontal diseases. Calculus formation can be prevented or controlled through diligent use of brush or fibre pencil. Gingival health can be maintained with clean teeth."

EMSLIE, R.O. The value of oral hygiene. Brit. D. J. 117:373-382, Nov. 3, 1964.

"The effectiveness of the Charters' scrub and roll methods of toothbrushing by professional dental personnel in removing plaque was studied in 60 United States Army recruits. An interaction between method of brushing and brusher was found, indicating that no one method was clearly most effective in removing plaque. One brusher removed significantly more plaque with the Charters' method than with the roll method, whereas the other brusher obtained a significantly greater reduction in plaque with the scrub method than with either the Charters' or the roll methods."

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FRANDSEN, Asger M.; Barbano, Joseph P.; Suomi, John D.; Chang, Jacqueline J.; and Burke, Allyn D. The effectiveness of Charters' scrub and roll methods of toothbrushing by professionals in removing plaque. Scand. J. Dent. Res. 78:459-463, 1970.

"The bacteriologic profile of selected tooth surfaces were determined before and after prophylaxis by use of culture methods and direct smears. (11 subjects ranged in age from 18 to 38 years; they had intact dentitions, slight to moderate plaque and calculus formation and no clinically significant periodontal disease) There was an initial increase in cocci after prophylaxis and a decrease in all other forms. The distribution of organisms tended to return to preprophylaxis levels in 30 to 60 days."

HANDLEMAN, Stanley L. and Hess, Charles. Effect of dental prophylaxis on tooth-surface flora. J.D.Res. 49:340-345, Mar.-Apr. 1970.

"Various oral hygiene procedures were evaluated in series of simulated space flights. Studies accomplished in a sealed Life Support Systems Evaluator. Precise caloric, water, and nutritional requirements, microbial population and personal hygiene procedures of man were studied under controlled conditions of space flight in four 30-day experiments. Results indicate that such procedures as are necessary to minimize dental emergencies must be accomplished three to six months before flight. Stomatologic pathoses should be evaluated for long-term prognosis. Oral hygiene procedures, from the ineffective use of sugarless chewing gum, through the partially effective use of rubber-tipped interdental stimulators and the satisfactory use of manual toothbrushing and 30 cc. of water to the very effective use of electric toothbrushes and ingestible dentifrice were evaluated. In the "average" mouth, conditions exist that can, under the complexity of environmental conditions in extraterrestrial missions, cause acute exacerbation of silent oral disease, seriously limiting performance. Oral hygiene instruction and kits are to be provided. An emergency "buddy-care" kit has been developed. A thorough training in emergency treatment must be given all candidates for prolonged space activities."

HARTLEY, J. L. Dental support of man in space. IADR Abstracts, 1965.

"A study of individual plaque scores from several clinical trials evaluating various toothbrushes indicating that a large part of residual group plaque scores was the result of habitual oversight of certain surfaces, particularly lingual, by many subjects even when brushing time was considerably greater than customary and the subjects had been told to brush all areas. It appeared, therefore, that a simple instructional device which would visually suggest an orderly, paced, pattern of brushing could lead to improved efficiency and decreased brushing time. A 10 inch dial was divided into 16 segments representing portions of the



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dentition. The pointer rotated 360 degrees in 90 seconds. A group of 49 non-dentally oriented young adults brushed with a hand and electric toothbrush without and with the instructional device. Unpaced brushing times averaged: hand - 150 seconds; electric - 168 seconds. Paced brushing for 90 seconds gave statistically significant lower residual plaque scores on lingual surfaces for both types of brushes; hand 23.41 vs. 11.37, Critical ratio 3.52; electric 25.22 vs. 14.90, Critical ratio 2.74."

HEIN, J.W.; Quigley, G.A.; Soparker, P.M. Improvement of toothbrushing efficiency through the use of a mechanical instructional device. IADR Abstracts, 1969.

"Charters method" and "Roll method" are discussed. "The dentist's teaching should not be restricted to a single technique of oral hygiene, but modified to meet the individual needs of different patients.....Today greater emphasis is being placed on the need to teach patients why they should clean their teeth rather than to teach a particular method. Credit for this change in philosophy is largely due to "Arnim" who showed that bacteria-laden debris was consistently located at the dentogingival junction and could be demonstrated by using a disclosing stain."

HENNING, F.R., and Lanning, Elizabeth A. Instruction in oral hygiene. Aust. D.J. 13:40-45, Feb. 1968.

"Individual differences in toothbrushing force are reflected on the formation of habits of brushing procedures among school pupils. Brushing force is found to be 100~500 g. for school pupils and 50~250 g. for pre-school children. When a brushing effect percentage is kept at 100 percent, brushing force is inversely proportional to the number of brushing strokes. Debris removal effect is to be accurately evaluated not only by brushing force but also by a product of brushing force times the number of brushing strokes."

KAKUDO, Yukio; Hieda, Toyoji; Matsusawa, Sakae; Ishida, Akira; Yoshihara, Masahiko and Nakajima, Yasunori. Relations between brushing force and the number of strokes during toothbrushing in pre-school children and primarily school pupils. J. Osaka D. University, v3, #2, 187-199, 1969.

"The amount of dental plaque disclosed on the teeth of 37 dental students by merbromine was evaluated by means of the Quigley and Hein's Index. The plaque was scored before and after restraining. The average index for the 37 students was 3.2 before toothbrushing, 0.5 after toothbrushing without restraining, and 2.1 after restraining. These figures demonstrate that even if practically all dye is removed a substantial amount of plaque may remain on the teeth. The investigation also revealed that the students' subjective evaluation of tooth cleanliness was unrealistic. It was concluded that disclosing agents are important for the effective control of

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oral hygiene and that it is necessary to apply the disclosing agent after toothbrushing in order to reveal residual plaque."

KARDEL, K. The use of disclosing agents. Tandlaeg 71:3-8, 1967.

(Abstracted from: J. Western Soc. Periodontology-Periodontal Abstracts 16:29, 1968.)

"Instructed oral hygiene--the mechanical breaking up of the cuticle before maturation into full-blown plaque is presently the only prevention technique available. It must be taken seriously by the profession. Dr. Ronald B. Odrich, Assistant Professor, Department of Periodontics at Columbia, then presented a review of the techniques for patient instruction in oral hygiene he used in his office. Everyone on his staff, secretary, hygienist and doctor, thinks plaque and talks about it. At the first visit, the accumulation of plaque is graded, charted and related to inflammation. At the second appointment, the hygienist will describe the process in detail - using a handmirror for the patient. A sample is removed from the patient's mouth and placed on a slide for viewing in phase-contrast microscope. This is a dramatic demonstration for the patient and an effort is made to present the problem in a non-threatening way. The sight of all those living, swimming creatures could be frightening to the layman. Disclosing solution is then applied to the mouth and brushing and flossing instruction given. This is followed by a second disclosing application to check the results. The patient is sent home with a kit of mouth mirror, brush, floss and disclosing tablets and the entire office procedure is repeated four times at succeeding appointments for reinforcement.....Specifically, Dr. Odrich recommends the Bass brushing technique wherein the bristles are directed into the sulcus. A soft, round-bristled nylon brush is necessary, such as the Lactona 19 or M39. Floss is considered the only tool that can disorganize plaque subgingivally. Goose quills, plastic tips and pipe cleaners are used for interproximal and furcation supragingival areas. The Water-Pik is an excellent device for gross debris and "pre-plaque" removal, but cannot remove organized adherent deposits."

KARNOFF, Elias M. (First District Reporter) The plaque diseases - nature and prevention. N.Y.J. Dent. 40:208-209 June-July 1970.

Conclusions; "1) The data is quite conclusive that it is better to use a dentifrice than just water to clean the proximal surface. 2) Evidence is not conclusive that there is any appreciable difference between hand-brushes and electric brushes for cleaning proximal surfaces. 3) Evidence is not conclusive that a horizontal or vertical action of an electric brush is better for cleansing a proximal surface. 4) Evidence is not conclusive that synthetic or natural bristle handbrushes are better for proximal cleaning. 5) There does seem to be some indication that either an intermittent forced water stream or dental flossing is a good adjunct for cleansing the dental proximal surface. 6) There is need for further study using different dentifrices, synthetic and natural bristle hand-

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brushes, electric brushes with different actions and combinations of handbrushing with flossing and handbrushing with the water jet."

KELLER, S.E. and Manson-Hing, L.R. Clearance studies of proximal tooth surfaces, Part II: In vivo removal of interproximal plaque. Ala. J. Med. Sciences 6:266-274, 1969.

Two groups, 50 each, from dental practice patients. One group was individually taught the roll or modified roll technique; other groups taught soft brush as advocated by Arnim. The roll technique was found practical after one instruction visit for most patients (70%). Soft brush practical for only (24%). After a second instruction visit, use of soft brush was as acceptable as roll technique....Note: Disclosing solution used. Soft brushes used: Oral B; Lactona M39; ProPerio.

KIMMELMAN, Benedict B. Teaching two toothbrushing techniques: Observations and comparisons. J. Periodont. 39:96-100, Mar. 1968.

Thirty-three female subjects, 18 to 23 years, were examined 36 times over a three month period. Results: Gingivitis is a fluctuating disease in which areas of gingivitis may spontaneously heal and become normal, and normal areas may develop gingivitis within a short time period. The prescribed method of toothbrushing (Modified Stillman's Technique) is an effective method of decreasing the number of and fluctuations in gingivitis. The effects of the prescribed method of brushing wear off rapidly since the number of fluctuations in gingivitis increase rapidly with cessation of the prescribed method of toothbrushing.

IARATO, D.C; Stahl, S.S.; Brown, R., Jr.; Witkin, G.J. The effect of a prescribed method of toothbrushing on the fluctuation of marginal gingivitis. J. Periodont. 40:142-149, March 1969.

Oral Hygiene Aids: "1) Plaque detection - Chewable disclosing wafers containing erythrosine which stains plaque film red should be used to demonstrate the exact location and extent of plaque accumulation in the patient's mouth. However, the dye cannot be used to demonstrate plaque located subgingivally, since many periodontal pockets are too deep, and the dye does not penetrate into these areas. Plaque should always be stained when teaching patients how to brush. Until the patient demonstrates a proficiency in toothbrushing, the patient should stain plaque accumulations prior to brushing, to check the effectiveness of their brushing technique. Staining of plaque should be done at least once a day, preferably at the last brushing of the day. 2) Hydrotherapy - Studies using patients with periodontal disease have shown that individuals using water pressure cleansing devices have less plaque formation and inflammation and increase keratinization of the gingiva on the irrigated side versus the side that was only brushed. However, the difference in

plaque reduction was small. Crumley has reported that a high pressure water device causes less swelling and bleeding of the crestal gingiva but is of little value in deep periodontal pockets. Dunkin found that water irrigating sprays, when used with toothbrushing and flossing, removes microbes, improves gingival color density, anatomy, and reduces pocket depth. However, this study did not use controls, therefore the observed improvements in tissue health cannot be absolutely attributed to the device alone.....The effect of such devices have only been studied on patients with periodontal disease. No studies have been designed to determine the long-term effects of such devices in patients with healthy gingival tissues. Furthermore, unpublished observations describe a number of harmful effects when water pressure irrigating devices are used with too much force (see Sumner, C.F. ref. #14).

3) Toothbrushing - None of the methods of toothbrushing advocated at present are able to satisfactorily clean the interproximal tissues, particularly the gingival sulci and col areas. Intrasulcular brushing as suggested by Bass probably offers the best means of removing food debris and plaque from the gingival sulcus. The head of a soft multitufted brush with round tipped bristles of equal length is directed at a 45 degree angle to the long axis of the tooth with the tips of the bristles extending directly into the sulcus. The brush is then given a gentle lateral rotating motion, to dislodge sulcular debris. Intrasulcular brushing is a satisfactory method of cleaning the labial and lingual gingival sulci, but does not reach the col and adjacent crevicular epithelium. Brushing alone, therefore, no matter how carefully performed, does not provide a completely satisfactory method of interproximal cleaning.

4) Mouthwashes - Although mouthwashes cause a temporary reduction in microbial counts, similar results can be achieved using warm water.....reduction in bacterial counts in the mouth after rinsing was of a slight duration. Mouthwashes must, therefore, be considered an ineffective means for interproximal cleansing.

5) Dental tape - Unwaxed dental tape provides an excellent means of cleaning the subgingival areas of the interdental papilla and removing debris from the proximal root and crown surfaces. Waxed dental tape is too thick to pass easily through the contact areas, and plain dental floss has only a single cutting edge for removing debris. Unwaxed dental tape is easily passed through the contact area with a gentle sawing motion so that the tape does not suddenly snap through the contact area and traumatize the gingiva. The tape is then gently applied against the proximal surface of the tooth in an up and down sawing motion. Pressure of the tape against the tooth causes the filaments of the tape to separate, forming a number of individual cutting edges which remove the debris. After one proximal surface is cleaned, the tape is brought occlusalward, passing the tape gently over the crest of the papilla. It is then applied against the proximal surface of the adjacent tooth and into the gingival sulcus, repeating the wiping motion. If a soldered contact area of a fixed prosthesis is present, the tape may be threaded into a small loop formed at the end of a fine wire, which is then passed under the contact area of the solderjoint. The wire is removed then leaving the segment of tape under the contact area.....

6) Interproximal stimulation - Rubber topping of the interproximal papilla where space exists will aid in cleaning the area of debris and

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plaque and encourage keratinization of the epithelium of the interdental col. A rubber tip will not remove debris and plaque from the subgingival space.....A number of investigators feel that keratinization enhances tissue health, while others believe that the benefits of tissue massage are questionable since it is the removal of plaque and debris during the process of massage that is the primary cause of improved tissue health. An interproximal stimulator should not be wedged against a firm healthy papilla that fills the interproximal area, since this will traumatize the tissue. Soft wooden interproximal stimulators can be used to polish proximal root surfaces and cleanse the interproximal areas. However, wooden stimulators tend to splinter and are difficult to use in the molar areas. Wool yarn is an excellent material for cleaning the interproximal areas where space allows, since wool does not fray, picks up debris by virtue of its porous surface and polishes the proximal tooth surfaces. Pipe cleaners have also been used for interproximal stimulators."

LARATO, D.C. Oral hygiene aids and restorative procedures related to interproximal tissue health. J.S.C.D.A. 38:343-346, Apr. 1970.

"Motivating patients to brush properly is one of the most perplexing problems in the practice of preventive dentistry. Many patients, though sincere in their desire to perform their home care properly and efficiently, have achieved only mediocre results ....it was decided to delve into this problem. Brushes and toothpaste were purchased and patients whose brushing habits were poor were asked to brush their teeth in the office. Each patient was left alone and instructed to do an excellent job.....The brushing was timed, unbeknown to the patient, and amazingly only one out of 40 to 50 brushed as long as one minute; most brushed 20 to 30 seconds.....Their brushing habits were subsequently studied and the conclusion was reached that those who have trouble getting their teeth clean, though wishing to do an excellent job, unfortunately stop brushing when their mouth fills with soap and saliva. The time elapsed seems long to them and when they empty their mouths, they rinse the brush and stop.....One of the solutions to the problem has been to emphasize the time element, two minutes by the clock, to encourage the continuance of brushing after the rinse without going to the trouble of reapplying toothpaste to the brush. The results have been gratifying to us, and it is hoped that our experience may help others who have had the problem of motivating patients."

LARSON, Arnold O. A study of brushing habits. Northwest Dent. 49:120, Mar.-Apr. 1970.

"Toothbrushing techniques: "Charter's method, slightly modified by Ramfjord, most effective. Stillman's next best, and Fone's the only other acceptable method. Charter's does everything we could wish a toothbrush to do.....it makes contact with the gingival margin areas, the points move between the teeth thus distributing the food particles gathered there and the blunt side of the bristles confer health-giving

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massage to gingival tissues." Author also recommends vigorous flushing with water, interdental stimulation twice daily and disclosing tablets. Concludes with statement by Leatherman: "The whole concept of dentistry should change in that the course should be built around the maintenance of the supporting structures of the teeth, that is, the study and practice of periodontics."

LAVENDER, Gerald B. Periodontics in retrospect. Aust.D.J. 12:554-558, Dec. 1967.

"This rubber and sponge device is useful for improving oral hygiene in people with limited dexterity. It is known commercially as "Masti-clean" and distributed by Cleo Living Aids, 3957 Mayfield Road, Cleveland, Ohio 44121. The theory of operation is simply a mechanical scrubbing of the accessible areas of the teeth and a hydraulic flushing of the inaccessible areas. The sponge chewing device may be used with liquid, semi-solid, or powered agents applied to the sponges. No dexterity is necessary except the ability of the patient to chew after the device is inserted.....Generally there was an improvement in the gingival conditions of the patients."

LEVENSON, Myron F. Oral hygiene and self-care. A method of oral hygiene and self-care for the teeth or gingiva. Am. J. of Occupational Therapy 22:209, May 1968.

"....Although there are many good reasons for eating fruits and vegetables, it should be realized that adequate oral hygiene cannot be established by occasionally eating an apple; a snack of fruit at bedtime cannot substitute for regular oral hygiene procedures. Attempts to eradicate oral bacteria by various types of disinfectants are not practical due to the dangerous side effects which may follow. Attempts to clean the teeth by enzyme-containing chewing gum or dentifrice have not been successful. The most common method for cleaning the teeth is toothbrushing..... Charter's method is recommended.....Adequate oral hygiene cannot be attained by one minute of brushing which is the time spent by most people. ....Methods of oral hygiene should be adapted to the need of each patient. There is no standard universal method that fits all."

LOE, Harald Home care for the dentition. T Sygeplejersker 68:200-204, May 1968.

"Effect of subgingival scaling and controlled oral hygiene was evaluated over a period of five years in group originally consisting of 1,428 men and women. This analysis clearly demonstrates that strict hygienic measures are effective tools in the prevention of gingivitis. However, absence of pathologically deepened pockets is essential for success. Thus, the hygienic measures should start as early as possible in life."

LOVDAL, Arne; Arno, Arnulf; Schei, Olan; Waerhaug, Jens Combined effect of subgingival scaling and controlled oral hygiene on the incidence of gingivitis. Acta Odont. Scand. 19:537-555, 1961.

"Common injurious factors listed by Hirschfeld (1934) by faulty tooth-brushing as instrumental in causing gingival recession were: use of a long, brisk stroke, use of excessive pressure, faulty sequence in tooth-brushing, prolonged brushing in a habitually favored area and forcing the bristles into the subgingival crevice.....It was interesting that in the studies of Gorman and O'Leary et al, gingival recession was more frequent in patients with good oral hygiene.....one might conclude that while good oral hygiene is a vital factor in maintenance of dentition, the dentist should properly instruct the patient on toothbrush technique and discourage the use of a hard bristle brush."

MANNE, Marshall S. Gingival recession. Greater St. Louis Dental Soc. Bull. 42:120-124 May 1971.

"Caries is an infection.....Dental caries is transmissible.....The clinical procedures involved in a comprehensive caries control and caries prevention program are as follows: 1) Eliminate all bacterial plaques from all enamel and dentine surfaces. Use a non-abrasive prophylaxis paste containing stannous fluoride. 2) Follow by use of acidulated fluorophosphate solution in a gel, held within a mouth tray, to thoroughly impregnate the mature, intact enamel surface layer. 3) Follow by the daily use of fluoride containing dentifrice by the patient, to replace the fluoride ions lost from the surface enamel by the washing action of saliva and food. 4) Use of disclosing solution or tablet after the prophylaxis to insure complete plaque removal from all enamel surfaces. 5) Instruct each patient in the use of a disclosing tablet, to insure effective home care in preventing plaque accumulation. 6) Open all carious dentinal lesions. Remove the infected layer only. Seal a sedative dressing into cavity to promote healing of dentine and pulp. The cariogenic flora becomes depressed or even eliminated in 48 hours after removal of all infected cariogenic plaques from all enamel and dentinal surfaces. 7) The optimal time for elimination of cariogenic flora is (in children) just before restorative procedures are begun. 8) Optimal time for fluoride application in prophylaxis past plus gel is (in children) soon after eruption of new teeth - within six months; (in adults) immediately after completion of restorations and just before insertion of appliances. 9) Reduction of cariogenic sucrose containing snacks especially between meals. Remove "sweets" from diet by substitution, not by chiding or punishment. (Note: Table of substitutes included in article) 10) Oral Hygiene. 11) Preventive dentistry is profitable in educated population groups.....Processing of 'natural foods' increases sucrose content:

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Examples	<u>Non-cariogen</u>	<u>highly caries conductive</u>
	peanuts	peanut butter
	grapes	raisens
	whole wheat	white bread"

MASSLER, Maury Changing concepts in prevention and treatment of dental caries. J. New Jersey St. D. Soc. 40:311-317, April 1969.

"The latest scientist to add extensively to our knowledge of the oral environment is Arnim. Stimulated by observations of Bass and others, he has provided us with a wealth of information about the dental microcosm, its action, and fortunately, its control. Thanks to his prolific writings and extensive cinemicrographic studies of dental microcosms, available as movies, dentists and patients see for themselves what goes on in the invisible world they carry around in their mouths."...Article describes oral hygiene technique: disclosing dyes, floss, brushes, water irrigators, auxiliary aids, etc..."Unless the patient has a manual infirmity or is just hopelessly clumsy, the initial instruction is always with the manual brush....If patient wishes to try the electric brush after learning the fundamentals well, the application of the proposed set of standards for technique evaluation can be used to determine its satisfactory performance. Use of the electric brush without instruction and follow-up testing is a highly questionable practice. The selection of the electric brush is subject to the same bristle and action standards as the manual brush, and this sharply limits the choice. Many automatics are deficient in both respects and should be checked by the instructor before being used. Once the novelty value of the automatic brush is gone, the same problem of motivation exists.....Much to-do has been made of the choice of floss. During the initial training period, whether waxed or unwaxed floss is used does not seem to matter. The main thing is the establishment both of the habit and an acceptable technique. Shredding of unwaxed floss on defective restorations and calculus ledges can give the patient serious reason for discontinuing what he already considers a distasteful chore. Later, after the correction of defects, the use of unwaxed floss can be recommended if desired.....The author prescribes two different kinds of irrigators. The preferred type is the faucet-attached model which is inexpensive, has no serious repair problems and meets the objectives with minimum hazard. However, it is fixed and also is largely dependent on existing plumbing. The other type is an electrically operated, pump-driven device which is portable when disassembled and properly packed for carrying. It is independent of plumbing, but dependent upon repair services. There is no perfect dental water irrigator on the market today.....Dental health, like success, is not a destination but a continuous journey."

MASTERS, Donald H. Oral hygiene procedure for the periodontal patient. Dental Clinics of No. Am. 13:3-17, Jan. 1969.

"A study of 175 preschool children compared the effectiveness of a child brushing his teeth with that of a parent brushing for him. Results: some



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three to five year olds are completely unable to wield a tooth brush. Scrubbing horizontally was more effective than the roll method. The parent brushed more efficiently after instruction."

McCLURE, David B. A Comparison of toothbrushing technics for the pre-school child. J. Dent. Children 33:205-210, May 1966.

".....Phase microscopy has proved most useful in overcoming neglect and apathy by engaging and activating patients' self-interest. People are more attentive to oral hygiene when they see bacteria taken from the necks of their teeth in frantic action. They also see the gelatinous microcosm that protects countless proliferating bacteria. We are factual in our demonstration. Should the operator use "scare tactics and inject strong emotion (fear), his patients will psychologically tune him out. This is an important observation".....Conventional microscope examination requires staining, because the specimen's refractive index is similar to that of the liquid. The dyes kill and possibly distort the bacteria. With phase microscopy we see live bacteria in action viewed with "optical" staining. We float the scrapings in various "antiseptic" mouthwashes so patients see how futile these rinses are. We might suggest to the patient that while disclosing rinses show where germ colonies are growing, he now sees what is incubating in his mouth. He might be informed about systemic, toxic infection, periodontal involvement and tooth loss. Actually, we need say little; the patient convinces himself. Phase microscopy puts real purpose into patient home care procedures and enthusiastic patients are our best source of referrals in preventive dentistry."

MITTLEMAN, Jerome. Getting preventive dentistry through to patients. Dental Clinics of No. Am. 14:309-315, Apr. 1970.

Author reviews work of Bass, Black, Barkley, Mittleman and states: "Dr. Bass decided that the key to success in controlling dental disease had to be found in disorganizing, or breaking up protective layers of bacteria. Brushing alone was not enough, since many of these germs between the teeth and in the gingival crevices could not be reached by the bristles of the toothbrush. Dr. Bass designed a special nonwaxed tape of dental floss and found that using this floss in a scraping motion removed the microcosms and disorganized the bacteria to the extent that they could not cause dental disease.....A special soft nylon polished bristle toothbrush was designed to clean the teeth, gums and interproximal areas. The weak link has been discovered. By flossing and brushing thoroughly once a day, the bacterial masses could be kept disorganized and dental disease arrested. It was also determined that 24 hours was required for this mass to grow back and reorganize efficiently to cause disease.

MORGAN, Turner T. How to save teeth - and enjoy dentistry. Miss. Dent. Assn. J. 26:12-14, 37-38, May 1970.

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Author gives detailed outline of clinical procedures that all general practitioners should perform in routine practice. The following is (II) from a (I) through (X) outline.

"II Training in preventive periodontal care (P.P.C.)

A. Indications:

1. For any patient having periodontal pathosis or dental caries (C.C.Bass has shown that bacterial plaque is related to both of these diseases.)

B. Objectives:

1. To daily disorganize, remove and control bacterial plaques by teaching the use of :
  - a. Flossing with unwaxed floss. This technique has been found to be the most effective for interproximal control of bacterial plaque, except where root concavities exist. This should be followed by all patients after age 15. (The age the incidence of destructive periodontitis goes up tremendously.)
  - b. Perio-Aid and World's Fair toothpick for interproximal root concavities and crevicular areas of teeth.
  - c. Jordan bottle brush (Oslo, Norway) or Butler proxibrush to remove plaque interproximally in large spaces.
  - d. Rounded tip bristled brush to brush into the crevicular spaces (Bass technic)
2. To stimulate gingival tissues by massage. This may or may not be needed and only one major aid has been noted. (Recontouring of minor bony defects interproximally.)....."

NABERS, Claude L. Periodontal therapy for the general practitioner. The Fortnightly Review of the Chicago Dent. Soc. 59:11-16 Jan. 15, 1970.

Study #1: Explore effects of the liquid "tube type" diet on gingival status and plaque accumulations when subjects employed their usual oral hygiene, but without a dentifrice.... Study #2: Explore the adequacy of two minimal procedures for oral hygiene.....Study #3: Examined efficiency of three oral hygiene procedures. 1) Bass technic. 2) Bass technic plus rubber tip. 3) Roll method, plus rubber tip. The subjects using Bass technic of brushing alone compared favorably with two groups using more time-consuming methods. Bass technic more effective on lingual and palatal surfaces.....Results indicate dentifrice not necessary for maintenance of gingival health and plaque removal for a 44-day period.

O'LEARY, Timothy J.; Stumpf, Arthur J., Jr.; and Sundberg, Paul V., Jr. Oral hygiene procedures in the presence of a "tube-type" diet. J. Periodont. 38:30-35, Jan.-Feb. 1967.

Authors have extensively investigated the modified roll and Bass technics for toothbrushing. These are described in detail with illustrations. Also use of floss described and illustrated. Disclosing wafers and rinsing recommended.....Modified roll indicated for: 1) labial and buccal surfaces. 2) when tissue contours normal. 3) if erosion present.... Bass technic

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effective for: 1) lingual surfaces of mandibular teeth. 2) when in presence of tori, exostosis, or irregular contours. 3) when class V caries is prevalent.....Toothpaste foams and prevents you from seeing if the brush is placed properly. Omit it when learning or use in a second brushing.....Rinsing alone will not remove bacterial plaque because of the fat-like material in plaque.

O'LEARY, Timothy J. and Nabers, Claude L: Instructions to supplement teaching oral hygiene. J. Periodontology-Periodontics 40:27-32, Jan. 1969.

"One can contrast the results of this study with the previous study in which approximately one of every three areas exposed to fluid from an irrigating device for ten seconds and immediately biopsied and carbon embedded in the crevicular tissue. Since none of the 38 areas tested in the present study showed a similar result, one can state that toothbrushing by two widely accepted techniques (Roll and Bass) did not have the same tendency to force particulate matter (carbon particles) into the crevicular tissue."

O'LEARY, Timothy J. Possible penetration of crevicular tissue from oral hygiene procedures: II. Use of the toothbrush. J. Periodont. 41:163-164, Mar. 1970.

A brief review of the various agents and procedures for oral hygiene, including; disclosing agents; tooth brushes; toothbrushing techniques; interdental cleaning agents; oral irrigating devices; chemotherapeutic agents. Disclosing agents: "The agents do not selectively disclose bacterial plaque but rather stain all soft debris, pellicle and bacterial plaque. Limitations to their usefulness in a home environment are imposed by the patient's inability to visualize some areas of the mouth, coupled with the inadequate illumination available in the average bathroom. No studies are available concerning the effectiveness in improving oral hygiene status with the use of the disclosing agent..... Toothbrushes: The few comparative studies of the effectiveness of various brush designs and type of configuration of bristles have not pointed out a clear-cut superiority of any one type. The results of one study indicates a possible correlation between the total number of filaments in a brush and its cleansing effect. Many periodontists apparently favor the soft or medium firm nylon bristle brush with a reasonably small head and square-cut or rounded bristle ends. The small head permits better access to the posterior parts of the mouth, a child's brush is often prescribed for the patient with a small mouth or with malpositioned teeth..... Toothbrushing technics:....we concluded that the superiority of the Bass technic in the mandibular posterior area was due, at least in part, to the lingual inclination of many mandibular molar teeth. The lingual inclination combined with the presence of the tongue can make correct execution of the Roll stroke difficult and somewhat ineffective..... Dental floss: .... either waxed or unwaxed, properly employed will effectively clean almost all proximal surfaces. There are, however, negative

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aspects to the use of dental floss. More chair-side instruction is required for a patient to become proficient in its use and it is more time-consuming for the patient to use, and its use is generally restricted to the bathroom.....Oral irrigating devices: The consensus is that these devices are useful for removing loose food particles and oral debris. Some studies have reported decreases in plaque formation with use of water irrigating devices, but most published reports do not support this finding.....It is entirely possible that the beneficial results observed from their use may be due in part to a motivating effect resulting in an individual carrying out cleaning procedures more effectively and with more regularity.....At present most oral hygiene agents and procedures are being used on the basis of clinical impressions and more research is needed....."

O'LEARY, Timothy J. Oral hygiene agents and procedures. J. Periodont. 41:625-629, Nov. 1970.

".....After periodontal therapy is completed, it is a vital necessity to train the patient in the care of his mouth. The average patient brushes his teeth one or two minutes daily. Periodontally-treated patients must be made to realize they must use every "tool" at their disposal to cleanse and stimulate their teeth. Proper brushing, such as the Bass technique, must be taught. Arnim's recommendations must be followed along with the use of tape, stimudents and pipe cleaners to insure a thorough cleansing."

PERRY, Ellis R. Periodontics yesterday, today, and tomorrow. J. Miss. D. Assn. 25:9,13,15,18,24-26, 35 Winter 1969.

Important facts for oral hygiene: "1) The investigation of the causative agents in oral diseases. 2) The histopathology of the initial lesions of odontal and periodontal disease. 3) The analysis of the geographical location of the oral lesions in the mouth and corrective measures instigated early to provide proper cleansing in those areas. 4) The means to provide functional stimulation and development of jaw to resistance of infective agents. 5) The study of dark-field and phase microscopy of the infective agents and the histopathological studies of the diseases of the mouth and understanding the etiology and nature for their control 6) Use of disclosing agents along with an educational light magnified mirror (Floxite Co.) to understand the seriousness of oral uncleanness and to be motivated to demand and obtain by professional and personal responsibility oral cleanliness. 7) The restoration of the oral tissues of normal functions and professional cleansing of the mouth with professional checking of results every six months to assure that the patient has the means to maintain his oral cleanliness."

PETERSON, Charles T.: The nature of oral cleanliness. Jrl. Irish Dent. Assn. XIII:96-98 Aug.-Sept. 1967.

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"It is apparent that only a healthy periodontium and oral tissues can provide for a healthy tooth. The mechanical cutting of odontal and periodontal tissues and restorative procedures on the resultant lesions is not the answer to the extensive oral maladies now present in America. It is also evident that biochemical cleaners will not prevent oral sepsis and give healthy mouths.....It is the cleaning out of the contents of the gingival crevice and cleansing the whole mouth with cleansers based on biological principles which is the key to oral cleanliness. The insidious and infective agents in the periodontium must be identified and prevented as the important part of the health sciences. Research studies must be directed to causative analysis of the contents of the gingival crevice and not to the resultant odontal and periodontal lesions."

PETERSON, Charles T.: Oral Health Care. Dental Concepts. 11:22-23, Spring, 1969.

"Total oral hygiene treatment consists of assessing and controlling the microorganisms as the causative agents and maintaining healthy oral tissues to resist disease.....For many years in the western world, toothbrushing has been synonymous with oral hygiene. In nearly every other part of the world oral hygiene has consisted of frequent rinsing of the mouth plus the use of an interdental brush. This brush was often made from a chewed twig of a specific tree.....Patients who carry out a daily personal oral hygiene program along with regular professional assistance can maintain healthy teeth and oral tissues throughout life. To carry out such a program, the patient must clean all areas of the mouth - the exposed tooth surfaces, the oral tissues, the interproximal areas and the gingival crevices. This involves more than just using a toothbrush.....Adequate oral hygiene becomes the responsibility of both the dentist and the patient. A comprehensive oral hygiene program that will allow both to meet their respective responsibilities follows: Dentist's responsibilities : 1) Instruction and training as a habit for the cleaning of the gingival crevice and interproximal areas. 2) Instructions in brushing the exposed surfaces of the teeth, tongue and oral tissues of the mouth, night and morning with an oral brush and proper mouth cleaners. 3) Instruction as to routine rinsing of the mouth. 4) Use of disclosing tablets or stains to help patient understand need for personal oral hygiene. 5) Educating the patient of the ravages of oral disease so as to motivate the patient to want to help himself prevent oral disease. 6) The restoration of the oral tissues to normal function. This includes hard and soft tissues. 7) Professional cleaning and examination of the patients mouth on a regular basis. Patient's responsibilities: 1) After each meal remove debris from between all teeth with an interproximal cleaner and rinse mouth with water. 2) Night and morning clean all surfaces of the teeth and supporting tissues and tongue with oral brush and rinse out thoroughly with water. 3) Obtain professional assistance and guidance, a minimum of every six months.....The comprehensive oral hygiene program is effective because: 1) Dentist cleans where patient cannot, and sets a standard. 2) Patient cleans when the dentist cannot clean. 3) Cleaning

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debris from interproximal areas permits circulation of fluids between teeth and makes the mouth more "self-cleaning. 4) Adequate oral hygiene becomes a habit.

PETERSON, C.T. Effective oral hygiene treatment. Dental Students Magazine 48:188, Dec. 1969.

1. Initial and periodical comprehensive oral prophylaxis by professional care to clean all surfaces and areas and prepare the mouth so that the patient can maintain daily cleansing. 2. Daily removal of fresh debris and infective material from the gingival crevices, from between the teeth and from all surfaces and areas of the mouth by the patient's personal oral hygiene care....ABC's of Oral Hygiene: A) Oral prophylaxis by dentist: Thoroughly cleans the mouth, all the interproximal areas, the gingival crevices and the exposed surfaces of teeth and periodontal tissues. Oral prophylaxis prepares the mouth so that patient can maintain cleanliness at home. Rough fillings and extended inlays are corrected and smoothed and the normal paths between the teeth cleared for convenient movement of interproximal cleaner and prevention of stasis in the mouth. B) Patient maintains cleanliness of interproximal areas by using an interproximal brush such as "Tooth Flox". A soft brush-edge provides a means to clean out the infective material from the gingival crevice as well as between the teeth areas conveniently after each meal. C) Patient maintains cleanliness of exposed surfaces of teeth and oral tissues night and morning with an oral brush and cleanses all surfaces. This is a universal and important habit.

PETERSON, Charles T. Two tasks for effective oral hygiene. N.Y.J. Dent. 40:84-85, 90, March 1970.

"Thus there are two simple habits for mouth care: 1) After each meal remove fresh debris and infective agents from between the teeth with an interproximal cleaner such as "Tooth Flox". 2) Cleanse exposed surfaces of teeth and oral tissues with mouth cleaners and an oral brush that will not injure the oral tissues. When these 'between-the-teeth' crevices are thoroughly cleaned out and the whole mouth cleansed, the insidious process of oral uncleanness is controlled. This could provide a healthy mouth throughout life."

PETERSON, Charles T. How to save your teeth throughout life and enjoy good mouth health. J. Wisconsin State D. Soc. 46:158,163, Apr. 1970. (Also J. Alabama D. Assn., Oct. 1969).

"An effective oral hygiene program can only be successful when there is skilled professional services and the patient shares in the responsibilities. Professional service cleans out the hardened plaque and debris from the approximal sides of the teeth and the irritations from the gingival crevice. If the oral tissues are healed and are firm against

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the teeth and the rough and rubbery substances are removed from the approximal surfaces, then the patient can cooperate to accomplish a successful and complete oral hygiene program."

PETERSON, Charles T. Odontal and periodontal prophylaxis for oral hygiene care. Texas D.J. 88:17-20, May 1970.

Article discusses work by W. D. Miller, 1880, classifying 21 varieties of fungus in the carious lesion which he said produced acids. About the same time G. V. Black stated tooth decay was caused by an infective agent. Author goes on to briefly describe research by H. K. Box, 1913, Bodecker, Bass, Arnim and others, and concludes that this research resulted in the fact that ".....it is becoming more and more apparent that brushing and repairing the tooth does not solve the causes of oral uncleanliness. In fact it increases the problem.....It is evident that 'filling' teeth does not correct the infection in the mouth, but may create sepsis to the remainder of the body....Most present recommended methods for oral hygiene do more to increase oral uncleanliness than to eradicate them. Brushing teeth only pushes the cleaning agents (cosmetic dentifrices) and debris between the teeth, blocking the interproximal paths, creating virulent incubation zones and interfering with the natural self-cleansing action of the mouth. If professional prophylaxis included effective cleaning of the interproximal areas and gingival crevices as well as the exposed surfaces of the teeth and a small interproximal brush kept this clean after each meal - then cleansing the mouth night and morning would be effective. If professional prophylaxis included the cleaning out of the natural pathways between the teeth and the patient encouraged to keep this clean with an interproximal cleaner, such as Tooth Flox, hardened plaque and tartar would not form between the teeth."

PETERSON, Charles T. Paradigm of progress in mouth care research. Pakistan Dental Review XXI:49-52, April 1971.

"Conclusions: 1) The examiner's results were most consistently alike when they used the PHP method than when they used the DI-S method. 2) Each examiner was able to repeat the PHP examination with a high degree of consistency. 3) The PHP method is sufficiently sensitive to justify its use in dental health education and research."

PODSHADLEY, Arlon G; and Haley, John V. A method for evaluating oral hygiene performance. Public Health Rep. 83:259-264, Mar. 1968.

"The intention of this paper is to ask two questions about the methods available for preventing dental disease. Do they work? and if they do, how well do they work in relation to time and effort needed to effect them, or if they do not, is there any reason why we would not abandon them?.....It is an inescapable conclusion from epidemiological studies

in war time, in institutions and in geographically isolated communities that severe restrictions of fermentable carbohydrates is the most effective single method of preventing dental caries. Control of the diet to the extent needed in a free and permissive society appears to be restricted to the dedicated few. The only positive contribution in this context in recent years is the incorporation of phosphates in one way or another with the refined carbohydrates such as breakfast cereals, sugar and flour. (see Harris et al 1968).....F-tabs: The range of reductions in DMFS is partly dependent on the age when the tablets were started and partly on the duration of the study, but clearly indicates that the measure is a valuable one, though not comparable to the effect of fluoridation of the water supply.....Rinsing: In 156 officers, Bernier and Muhler (1966) compared for one month the value of rinsing alone with brushing after meals and with the use of wood points. Using the Oral Hygiene Index, Periodontal Index and Calculus Index, the mean scores for each of these was worst for the water rinsing group. Thus, however intellectually pleasing the concept may be of rinsing with water after meals there seems to be no evidence that it has any value in reducing caries...Solutions containing Fluoride: Incorporation of fluoride in dilute solutions into the rinse demonstrated a highly significant reduction in caries using fortnightly supervised rinsing with 0.2 percent F- or daily rinsing with 0.05 percent solutions of fluoride in school or when visiting a dentist. In the Gotteborg and Koch (1967) study, a greater reduction was produced by daily rinsing with a very dilute solution than by all the other methods under trial....Topical application of high concentrations of fluoride: Goaz et al. (1966) using six percent solution on nine year old children found a reduction in caries increments of DFS to be 52.3 percent in 21 months. Combined F-Methods: A combination of techniques, i.e. prophylaxis using F- paste, topical application of SnF<sub>2</sub> and tooth-paste containing SnF<sub>2</sub> has been shown by Bixler and Muhler (1964) to completely stop caries. However, this work rather surprisingly does not appear to have been followed up and must await confirmation. Prophylactic Odontomy: Needs more evaluation. Preservation of intact pits and fissures is currently being attempted with cyano-acrylic resins - preliminary results look encouraging. Brushing: One is forced to the conclusion that brushing as it is normally practiced is of little or no value in preventing caries.....Except for establishment of good habits, it is difficult to see that there is any value in tooth brushing for children under six, i.e., prior to the eruption of permanent teeth. I feel sure we should change our attack and preach brushing for periodontal reasons. First the evidence for benefit to the supporting tissues is proved beyond doubt; second, it has a strong cause and effect relationship which the parent can demonstrate for himself; and thirdly, it can be encouraged for social reasons. The epidemiological evidence of Greene (1963) and Sheihan (1969) in this country demonstrates the rapid progression of periodontal disease which is attributed to the almost universally low standard of oral hygiene."

PICTON, D.C.A.: Some aspects of practical preventive dentistry. Dental Health 8:43-48, July-Sept. 1969.



"Elimination of the acute phase of an ulcerative gingivitis and a lateral periodontal abscess are described. The need for thorough scaling and polishing and achievement of a high standard of oral cleanliness by the patient before embarking on any periodontal surgery is stressed. The use of disclosing rinse is described. This consists of a solution of 11.8 gms. of erythrosin in 100 ml. of distilled water, together with one crystal of thymol, six drops of which are placed in a small quantity of water to produce the rinse. It is recommended that no special method of brushing should be taught, but rather that the patient should be instructed to 'get it off', the 'it' being the stained plaque. The interspace toothbrush is also strongly recommended for cleansing the proximal surfaces of teeth adjacent to interdental spaces."

POWELL, R.N. and Alexander, A.G. The treatment of periodontal disease 4. initial preparation of the mouth. Brit. Dent. J. 119:522-524, 1965.

"The patient hygiene performance (PHP) method has been used to measure the amount of debris on teeth. The report presented tested the validity of the PHP (see Podshadley, A.G., Publ Health Rep. 82:259-263 Mar. 1968) method as a measure of behavior during the brushing of teeth. Each of four groups of college students was assigned differing amounts of time to refrain from toothbrushing. The time ranged from one to four days.. ....The dentists used the PHP method without knowing the group to which the students belonged. The results indicated that the PHP technic is a fairly valid and reliable measure and is feasible to use for evaluating dental health programs in which toothbrushing is the dependent variable."

RAMIREZ, Albert; Lasater, Thomas M.; Bethart, Hector and McNeal, Donald R. The patient hygiene performance method as an indication of behavioral change following persuasive communications; a study of validity. J. Public Health Dent. 31:188-190, Summer Issue 1971.

"1) Charter's 2) Modified Fones 3) Roll 4) Scrubbing. Ten fourth year dental students - short program of four weeks chosen to lessen effect of waning enthusiasm. In this group, the simplest horizontal toothbrushing method was the most effective in removing stainable plaque from buccal and lingual tooth surfaces. There was no clinically significant difference between the Modified Fones and Roll toothbrushing methods; but the Charter's method resulted in significantly higher oral hygiene scores when compared with the three other brushing methods."

RODDA, John C. A comparison of four methods of toothbrushing. New Zealand D. J. 64:162-167, July 1968.

"Unwaxed dental floss, in the proper hands, does an excellent job as it contours itself to the convexities of the teeth, but this is more beneficial in the removal of soft subgingival debris. Because floss or tape cover only a small area, they do not remove plaque well. This disadvantage can be overcome by using three-ply synthetic yarn in conjunction

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with the floss. The yarn is an effective vehicle for carrying desensitizing solution and stannous fluoride tooth paste into the interdental area and may be used at home by patient. Using the yarn routinely produces a burnishing effect on the root surface making it harder and smoother and less conducive to accumulation of food debris and plaque formation.....Use of disclosing solution as suggested by Arnim is an effective way of demonstrating to the patient the need for cleansing the root surfaces on all sides. The method described is an adjunct to oral hygiene which is designed to fit the requirements of a specific area - the interproximal surfaces."

SMITH, Joe H.; O'Connor, Tod W. and Radentz, Wm. Oral hygiene of the interdental area. Periodontics 1:204-206, Sept.-Oct. 1963.

"When patients are given the answers to 'who' - 'when' - 'how', they will almost certainly keep their own teeth for as long as they live".... Author divides his patients into age groups and recommends a different treatment plan for each group. He uses an illustrated booklet and patients participate in toothbrushing demonstration....."Summary: 1) Community Water Supply should be fluoridated. 2) parents must brush child's teeth from age two to eight. 3) Teeth should be examined, cleaned and fluoride applied by dentist regularly. 4) Fluoride toothpaste and home care equipment: irrigator; electric brush; stimulator; tape; gauze squares; mouthwash; toothbrushes, various textures. 5) Reduce snacks. 6) Brush teeth 'within split seconds' after eating....."

STUART, Robert Sterling Preventive dental care - a health message for patients. Dental Survey 45:32-38, Mar. 1969.

"The toothbrush is the most valuable instrument available to the patient for cleaning the mouth. Since natural bristles are no longer readily procurable from Red China, efforts have been made to improve the nylon filaments. A .012 or .014 filament is ideal for the roll technique of toothbrushing. It is not, however, desirable for crevicular brushing such as advocated in the Bass technique. With this technique a smaller diameter filament is needed, perhaps .006 to .008 of an inch. Both techniques are satisfactory for cleaning the mouth providing the proper brush is used in the correct method.....The patient should be encouraged to use this adjunct (disclosing wafers) in the evening after the teeth have been brushed, to see whether plaque remains. Regular use of disclosing agents will do more to motivate the patient for proper home care than anything else."

SWENSON, Henry M. "H" is for hygiene. J. Indiana D. Assn. 47:530, Dec. 1968.

"A technic of oral hygiene incorporating the cleansing of tissue with gauze saturated in carbamide peroxide-glycerol solution proved helpful in perio-

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dental procedures, cleansing the teeth of debris and restoring the soft tissues to normal color tone and firmness. As an adjunct to toothbrushing in orthodontic cases, this procedure thoroughly cleansed the child's mouth and appliance at the same time, preventing gingival irritation in troublesome areas. Rinsing with the medicant promoted healing in oral surgery patients and maintained clean mouths in patients with fractured jaws who were temporarily unable to brush their teeth. Geriatric and physically handicapped patients benefited from mechanical cleansing action of this medicament incorporated into a routine of oral hygiene."

TASSMAN, Gustav; Zayon, Gilbert M.; Zafran, Jack N. Hygiene in problem patients. Dental Survey 39:35-42, Feb. 1963.

"Oral physiotherapy, when used as a preventive measure, supposes the environment around the teeth is such that oral health can be maintained with adequate care.....There is no more vivid or impressive an evaluation of plaque distribution than the use of disclosing tablets. Instruction in use of toothbrush should come first to the exclusion of all other devices. When efficiency is mastered, other hygiene aids may be indicated. A soft, multi-tuft, nylon bristle brush allows patient to direct bristles into the plaque protected areas with undue discomfort. To insist patients brush long and often may be an unnecessary burden. A more productive approach is to insist the patient thoroughly clean the mouth once a day, preferably before retiring." (Author also recommends toothpicks and irrigating sprays for maintenance of oral health.)

TUSSING, Gerald J. Oralphysiotherapy - a preventive philosophy in periodontal disease. Chronicle of Omaha Dist. Dent. Soc. 32:49-51, Oct. 1968.

Summary: "The teaching method of model presentation and reinforcement was described and demonstrated to be effective in teaching oral hygiene techniques to 96 sophomore dental students. (Model presentation and reinforcement, as the name implies, is a combination of two instructional procedures. Model presentation, a form of imitative learning, is the first. It consists of demonstrating a problem and then presenting a solution through the use of motor skills. In addition, the learner must have a clear idea of what is to be accomplished in order to solve the problem. By imitating the demonstration, under guidance, the learner acquires the necessary understanding of the movement required. With additional practice, his motor skills develop. Model presentation approaches the learning process primarily as the motor response to a problem situation. For the attainment of highest proficiency, it is important to strengthen the response by reinforcement. Reinforcement increases the probability that desired responses will occur in the future. It results, therefore, in improving not only the initial learning process, but also the retention of what has been learned.) Methods:

....The effectiveness of model presentation and reinforcement, as an instructional procedure, was examined by applying it to the development of oral hygiene skills in 96 sophomore students in the School of Dentistry at the University of Minnesota. These students were divided into groups of five or six. Each group was instructed jointly by two instructors according to the method of model presentation and reinforcement. Three twenty minute sessions of instruction were provided during the 1968 fall quarter. A surprise examination was then given during the winter quarter.....Session One: Toothbrushing techniques (Bass and Roll) and dental flossing were demonstrated on models. The individual components of these techniques were also explained. The students were given disclosing tablets and scored utilizing the Greene-Vermillion Debris Index Simplified (DI-S). They were instructed to execute the toothbrushing and flossing movements, under supervision, in their own mouths. If shown to be inadequate the movements were corrected. In this way the students were given a clear idea of what was to be accomplished in order to solve the problem.....Session Two: was primarily reinforcement. It was conducted three weeks after the first session. Each student was given a disclosing tablet to observe his level of performance. He was then asked to perform the toothbrushing method of his choice and to floss his teeth. Session Three: was evaluation, ten weeks after the start of the study....Session Four: surprise examination of the oral hygiene to determine whether the oral hygiene levels attained at the end of the model presentation and reinforcement program were maintained. It was conducted during the same time of day as the previous examinations.....In the example selected for this paper, an oral hygiene method was being learned. Although it could not be observed, it was reflected in the degree of oral cleanliness (DI-S) of the students. The statistically significant ( $P < .01$ ) reduction in DI-S scores following model presentation and reinforcement indicates that the method was effective in teaching a toothbrushing technique. Its effectiveness was even more apparent when examined in light of the effectiveness of previous oral hygiene instruction programs at the University of Minnesota."

ZAKI, Hussein A. and Brandt, Carl L. Model presentation and reinforcement - an effective method for teaching oral hygiene skills. J. Periodont. 41:394-397, July 1970.

## VI. TOOTHBRUSHES (design - comparisons)

"Gingival inflammation, bacterial plaque and supra- and subgingival calculus were assessed in two groups of 200 and these factors were related to the stated frequency of tooth brushing and the type of bristle used. In a group of 200 dental students brushing more frequently than once daily resulted in less extensive bacterial plaque on their teeth but had no significant effect on the prevalence and extent of supra- and subgingival calculus or gingival inflammation, nor did it reduce the number of plaque-positive tooth surfaces. In a group of 200 patients attending a dental hospital brushing more frequently was associated with a lower prevalence and extent of supra- and subgingival calculus, gingival inflammation, and bacterial plaque. The benefits reached an optimum when the teeth were brushed twice daily. Those students who used nylon brushes had significantly less subgingival calculus, less gingival inflammation and less plaque than those using a natural bristle brush, whereas those individuals in the patient group who used a natural bristle brush had less subgingival calculus than those who used a nylon bristle brush."

ALEXANDER, A.G. The effect of frequency of brushing and the type of bristle used on gingival inflammation, plaque and calculus accumulation. Dental Practitioner 20:347-355 June 1970.

"On the basis of present knowledge, it is doubtful that any toothbrush now marketed should be considered as a therapeutic device. Most brushes have some therapeutic effect if used correctly. Professional dental care and education of the patient in brushing are far more important than any specific toothbrush.....Periodontal disease is caused by many factors and there is no single therapeutic device or technic which is universally effective for the treatment of periodontal disease.....Conclusions: Manual and electric toothbrushes (G.E. and Broxodent) are equally effective. Electric tooth brushes (G.E. and Broxodent) cause no more abrasion or trauma than manual brushes when properly used."

ASH, Major M., Jr. A review of the problems and results of studies on manual and power toothbrushes. J. Periodont. 35:202-213, May-June, 1964.

"The Broxodent and G. E. electric tooth brushes are as effective as a manual brush in the prevention of dental plaque, (calculus too for G.E. only) and has the same effect on gingivitis, Periodontal Index, gingival recession and the depth of the gingival crevice as a manual toothbrush."

ASH, Major M. Jr., Rainey, B.L., and Smith, Wm. A. Evaluation of manual and motordriven toothbrushes. J.A.D.A. 69:321-325, Sept. 1964.

"Studies must be of a sufficient length of time to be of any significance. The most recent study by McKendrick, Barbenel and McHugh meets most of these criteria for an excellent investigation. A comparison was made

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between hand and electric brushes over a two year period in 103 university students. They found at the end of this time there was no evidence that the electric brush was more effective in reducing oral debris, calculus formation, or periodontal disease, or that one caused more recession than the other. These findings are in complete accord with those of Dr. Ash who published one of the finest studies in this area in 1964..... It must be concluded that a brush can be no more effective than is the person who uses it. In the final analysis, therefore, it is the patient's motivation and ability that is of the prime importance for success in any program of oral hygiene and not the gadgets he may choose to use in carrying out such a program."

BAER, Paul N. Hand vs. electric toothbrushes. J. District of Columbia Dental Society 44:9 Jan. 1969.

"Instances in which it is necessary to use toothpicks are extremely few." Thought them harmful. Believed that flossing the teeth was harmful as when it slips through it strikes the interdental gum with considerable force...."The ordinary coarse bristle brush, when vigorously used, may be quite a source of trauma to the gums. Though the enamel is hard, and not ordinarily damaged by rubbing with gritty substances, the necks and roots exposed from brushing or pyorrhea are much softer, and vigorous brushing finally grinds away trenches or depressions in the parts most exposed."

BASS, Charles C. and Johns, Foster M. Alveolodental pyorrhea. W. B. SAUNDERS CO. 1915, Chapter IX - Prophylaxis.

"Thirty-one dental students, age 21 to 28, completed experiments using seven different toothbrushes. Brushes #1-3 were classified as hard, #4-7 medium hard. The best cleansing effect was found for an unconventional brush, #7, designed to clean the buccal, occlusal and lingual surfaces simultaneously; and for #2 a relatively large, multitufted brush. These two brushes also had the highest number of nylon filaments of the seven brushes examined.

BAY, Inger; Kardel, K.M. and Skougaard, M.R. Quantitative evaluation of the plaque-removing ability of different types of toothbrushes. J. Periodont. 38:526-533 Nov.-Dec. 1967.

"Intra-individual study made of plaque-removing ability of four standardized nylon brushes that differed in respect of the stiffness and density of their bristles, performed on eight male students. Consisted of two parts in which the cleaning was performed with and without supervision. In the first part the periods were of two days during which no oral hygiene was practiced. At end of first period plaque was recorded without brushing beforehand, while at the end of the other two day periods the teeth were brushed by the roll technique, and the residual plaque was recorded by the

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Silness-Loe plaque index. In second part, periods were of five days. At end of first period the plaque was registered with brushing beforehand; during other periods teeth brushed once daily by the roll technique and terminated with registration of residual plaque. Experiments complete when all subjects had used each of four types of brush. There were no statistically significant differences in the plaque-removing ability of the brushes irrespective of whether the comparison was made for all the tooth surfaces, the individual surfaces or the tooth groups. The removal of plaque with the roll technique was unsatisfactory on the proximal surfaces, and, to a lesser extent, on the lingual."

BERGENHOLTZ, Axel; Hugoson, Anders; Lundgren, Dan and Ostgren, Anders. The plaque-removing ability of various toothbrushes used with the roll technique. Svensk Tandlakare Tidskrift 62:15-25 Jan. 1969.

"Objective - compare the efficiency of electric (Broxodent) and manual toothbrushes in the removal of plaque, materia alba, and soft calculus. The manual multitufted nylon bristle brush was used, in modified Stillman's technique; mode of application of electric brush duplicated that of hand brush.....Clinical examinations were made at seven and 14 days. Results of 110 examinations in 55 subjects revealed equal effectiveness of hand and electric brushing in 50 percent, greater efficiency of the Broxodent brush in 42 percent and superiority of the manual method in eight percent. Results can be correlated to the degree of the patients manual dexterity."

CHAIKIN, B.S., Goldman, H.M. Comparative efficiency of electric and manual toothbrushing in instructed subjects. I.A.D.R. Abstracts, 1965.

"Ninety-one patients were studied in 182 visits. It was concluded that patients without instruction could clean their teeth as efficiently or more efficiently with the Broxodent than with the manual brush."

CHAIKIN, Bernard S.; Goldman, Henry M.; Schulman, Sidney M.; Ruben, Morris P. Comparative cleansing efficiency of power-driven and conventional toothbrushes, I. Effect in uninstructed patients. Periodontics 3:200-202 July-Aug. 1965.

"....The power brush, when used on periodontally treated and maintained patients, was more effective in preventing calculus deposition. Natural bristles prevented plaque formation slightly more effectively than nylon bristles in both automatic and manual brushes, but there was no significant difference in the prevention of calculus except for some minor irritation in two patients during the first week, there was no evidence of any tissue damage from the power brush at the end of the 16 week observation period."...(30 patients...Pycopay brushes.)

CHASENS, Abram I. and Marcus, Richard W. An evaluation of the comparative efficiency of manual and automatic toothbrushes in maintaining the periodontal patient J. Periodont. 39:156-159 May 1968.

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Sixty females (age six to 50) institutionalized patients divided into three groups: (A) automatic G.E. brush by attendant. (B) hard, natural bristles, ten brushed by themselves, ten by attendant. (C) soft natural bristle brushes, ten brushed by themselves, ten by attendant. Group A using motor driven showed a significant decrease at end of weeks. Groups B and C showed no decrease. Group C showed increase in number of deposits at the end of one month.

COHEN, M. Michael and Winer, Richard A. Comparative effectiveness of manually and power operated toothbrushing on tooth deposits. Periodontics 2:122-124 May-June, 1964.

(42 children, 5 to 12 years, tested for three weeks)... "the modified arcuate reciprocating automatic toothbrush and the short stroke reciprocating automatic toothbrush were significantly more effective for the removal of plaque and debris than manual brushes. Teeth may be cleansed of plaque and debris with the automatic brushes used in this study more rapidly than with the manual toothbrush."

CONROY, Charles W. and Melfi, Rudy C. Comparison of automatic and hand toothbrushes: cleaning effectiveness for children. J. Dent. Child. 33:219-225 July 1966.

(29 subjects, female dental hygiene students and instructors - ten week program.) Conclusions: "The upper arch was cleansed more effectively than the lower arch. The superior cleanliness was attributable to the inherent ease with which the upper arch can be cleaned by either brushing technic. The electric brush was superior in overall cleaning effectiveness." Note: Broxodent and two row hard bristle hand brush used.

DERBYSHIRE, John C. and Mankodi, Surendra M. Cleansing effectiveness of conventional and electric toothbrushes: a clinical comparison. J.A.D.A. 69:317-320 Sept. 1964.

"Evidence of the important part the microbial mass plays in periodontal disease is mounting. An index based on the microbial population in health and disease would be most valuable. We took 60 subjects having them brush on one side of the mouth with the mechanical toothbrush (arc action-cord type) and on the other side with a hand brush to evaluate the effectiveness of the mechanical brush. The side used for the mechanical brush chosen by random numbers. They were instructed to clean their mouth well. Disclosing wafers used and subjects' notes on areas missed with each brushing technique were recorded. Original examinations were with P.M.A. (modified Greene and Vermillion) and collections were made on the four first molars to be examined by phase microscopic techniques and indexed as to contents, numbers, and motility. Five months later the same patients were examined and in almost every case where improvement of P.M.A. occurred there was a lessening of the microbes both in number and motility. On the mechanical brush side almost without exception there was a greater change in the micro-



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scopic picture for the better in comparison with the hand brush of same subject. It would appear that the microbial index might be a good tool to evaluate health and disease of the gingiva. The mechanical brush appeared to do a better job of cleaning the gingival crevices than the hand brush."

DUNKIN, R.T. Microbial index as a method of measuring effectiveness of mechanical toothbrush. I.A.D.R. Abstracts, 1965.

"The traumatic effects of poorly designed toothbrushes have been discussed. Results are given of a survey conducted in retail stores, pharmacies and supermarkets, to determine the toothbrush types available in Adelaide. Of the 51 brushes for adults on sale, only five were acceptable in design. (They had soft bristles with a flat trim and a straight finish to the bristles.) Eight brushes were available for children, but not one was entirely acceptable.....The child's brush should resemble the adults', apart from reduced dimensions and the provision of finer filaments to compensate for increased stiffness due to the shorter bristle length."

FANNING, Elizabeth A. and Henning, F.R. Toothbrush design and its relation to oral health. Aust. D.J. 12:464-467 Oct. 1967.

Two hundred fifty male dental students participated and were instructed in appropriate brushing technique. One group used Pycopay, medium nylon hand brush - other group used G.E. Electric. Examinations were repeated six weeks, seven months and eleven months after initial examinations. The variables evaluated were gingival condition; tooth stain; tooth surface debris; calculus. Conclusion: "An electric tooth brush is as safe and effective as a hand brush."

GLASS, Robert T. A clinical study of hand and electric toothbrushing. J. Periodont. 36:322-327, July-Aug. 1965.

"Supplementing powered toothbrushing with powered interdental stimulation reduced gingival inflammation to a significantly greater degree than toothbrushing alone. There was a decrease of 0.80 in microscopic inflammation after three months use of a powered toothbrush plus interdental stimulator which was significantly greater at the one percent level than the 0.17 reduction in gingival inflammation after three months use of the powered toothbrush alone. The microscopic findings are in accord with previously reported clinical observations. After three months of powered toothbrushing, supplemented by powered interdental stimulation there was an increase of 2.69 microns in thickness of surface keratin and/or parakeratin in the interdental gingiva, as compared with a decrease of 1.11 microns following powered toothbrushing alone. The difference between the groups is statistically significant at the one percent level. It is noteworthy that combining interdental stimulation with powered toothbrushing resulted in a statistically significant increase in surface keratinization and/or para-

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keratinization of the interdental gingiva. The significance of this change in terms of protection against local irritants and improved gingival health should be investigated."

GLICKMAN, Irving; Petralis, Richard and Marks, Robert M. The effect of powered toothbrushing and interdental stimulation upon microscopic inflammation and surface keratinization of the interdental gingiva. J. Periodont. 36:108-111 Mar.-Apr. 1965.

"A blind clinical evaluation of a new electric powered toothbrush with an elliptical motion (Pyocopay) was studied in two groups: 30 dental students used soft natural bristles while 36 nursing students used soft nylon bristles. Each group divided in half with one half using an electric brush in one jaw and a similarly textured manual brush in the opposite jaw. (There were no injuries to the soft tissues.) In the groups of well trained brushers (dental students), no significant difference was found between the brushes, while for the other group (nurses) there was a tendency to significant improvement in the P.M.A. Index between the beginning and end of the study period with the use of the electric brush." GOLDBERG, H.J.V.; Chilton, N.W. and A. DiDio Controlled clinical trial of a new electrically powered toothbrush. I.A.D.R. Abstracts, 1966.

".....it was found that a power-driven brush, utilizing an arcuate motion was more efficient in cleansing than a manual brush when individuals received no prior instruction with either brush. It was also found that individuals with poor manual dexterity performed better with the power-driven brush."...(Note: A very detailed method for technique of brushing is presented - an irrigating spray was recommended.) GOLDMAN, Harry M. and Ruben, Morris P. Methods for increasing the efficiency of the arcuate motioned, power-driven brush in oral physiotherapy. J. Periodont. 38:508-513 Nov.-Dec. 1967.

"In vitro studies on abrasion caused by hand and automatic toothbrushing motions and by nylon bristles, natural bristles and rubber-tip stimulators were performed. Comparisons were made on a weight-loss and a relative volume loss basis. In comparison with the short stroke, reciprocating-action automatic toothbrush, under simulated conditions, arcuate-motion automatic toothbrushing produced 160 percent more abrasion, and occlusal-ward hand toothbrushing produced 50 percent less abrasion. On ivory and acrylic resin, natural bristles caused about twice as much abrasion as nylon bristles. Bristle buckling and matting were found to be important factors in the abrasion characteristics of toothbrushes." HARRINGTON, John H. and Terry, Ira A. Automatic and hand toothbrushing abrasion studies. J.A.D.A. 68:343-350 Mar. 1964.

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"A comparison was made of five brands of electric toothbrushes to determine desirable characteristics for institutional use on handicapped individuals. The study showed a need for maximum convenience of operation in this type of environment. The most important single desirable feature was found to be the cordless operation."

HARRISON, Colleen C. Desirable characteristics of an electric toothbrush for institutional use. J. Periodont. 39:270-272 Sept. 1968.

In order to determine at clinical level the comparative abrasion on enamel surfaces that arises from routine use of hand toothbrushes and a short-stroke (3/16") reciprocating action electric toothbrush, the dimensional changes of all clinically detectable white spots in the enamel on buccal and labial surfaces of the teeth were determined in two groups of young adults. Eighty-nine subjects used electric devices. Eighty-five used hand brushes similar to ones they normally used. As measured by this criterion (described in article) based upon defective enamel, the electric device and hand toothbrushes were comparable.

HEIN, J.W., Quigley, G.A., and Soparkar, P.M. Comparable clinical abrasion of an electric and hand toothbrushes. I.A.D.R. Abstracts, 1966.

"Manufacturers of oral hygiene aids, as a general rule, make no effort to influence the public towards seeking more effective appliances. Rather, they have taken market surveys on the type of brushes which are in popular demand and have then tailored their volume of production to meet this demand. In this manner the public, largely uneducated, has continued to dictate the brush design.....The type of brush used will influence the health of the mouth by affecting the efficiency of brushing." Results: "Fifty-four percent of cleaning performed in relation to rising and retiring. Eighteen percent claimed to brush more than twice daily"

HENNING, F. R. and Fanning, Elizabeth A. Toothbrushing habits in a group of Australian dental patients. Aust. D.J. 12:274-276, June, 1967.

"Nylon displaces or pushes aside soft, homogenous material, such as emulsion on photographic film and heavy oil paint; natural bristle apparently grips and pulls off the soft material. During use, nylon filament apparently wears smooth and glides over the test surface, while the bristle continues to grip the surface. Under comparable conditions the quantity of material removed by natural bristle brushes was usually notably greater than the amount removed by nylon filaments. These experiments suggest that the natural bristle brush cleanses more efficiently than one with nylon filaments."

HINE, M. Kiplinger, Jr.; Wachtl, Carl; Fosdick, L.S. Some observations on the cleansing effect of nylon and bristle toothbrushes. J. Periodont. 25:183-188 July, 1954.

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"This study was intended to establish the effect of fluctuation of gingivitis areas in a toothbrushing test. It followed a more critical investigation which established that gingivitis is a fluctuating disease. Based on the changes which may occur in patients with gingivitis, the study presents a more accurate method of evaluating the effectiveness of toothbrushing on gingivitis. Of particular note is the observation that toothbrushing, even for one week by any method is advantageous to oral health. The increase in gingivitis in the no brushing group presents a base line which justifies personal oral hygiene. It is no longer irrational to suggest that toothbrushing can prevent gingivitis. The no brushing group also determined the time period of the study. Indeed, the disastrous result of one week's failure to brush terminated the study and the authors are grateful for the students' contribution. It is evident with the one week period that the reduction in initial gingivitis areas is constant. The difference arose in new lesions found in previously normal areas. This result establishes that toothbrushing may influence the number of new gingivitis areas arising from previously normal areas. In this study, the new automatic toothbrush significantly inhibited the formation of new gingivitis areas....."

HOOVER, Donald R. Lefkowitz, William Reduction of gingivitis by toothbrushing. J. Periodont. 36:193-197 May-June 1965.

"In a blind test on 71 dental students, an automatic toothbrush showed a decided advantage over a new hand toothbrush and routine home care to the patient with gingivitis. The automatic brush is simple to use, effective and more gentle to the tissues. The automatic brush is superior to the hand toothbrush in removing plaque from the teeth, and causes less injury to the gingivae of patients with gingivitis than does a hand brush. The gingivitis group was more susceptible to toothbrush irritation than the normal group. There was no correlation between the amount of plaque present on the teeth and the incidence or severity of gingivitis."

HOOVER, Donald R., and Robinson H.B.G. Effect of automatic and hand toothbrushing on gingivitis. J.A.D.A. 65:361-367 Sept. 1962.

"The universal prevalence of dental plaque and oral debris illustrates the failure of the general population to accept and utilize conventional methods of oral hygiene. Numerous brushing techniques have been shown to be effective in motivated individuals who have the benefit of intensive personal instruction and reinforced by periodic review. This, however, is not always possible or practical and the mechanical toothbrush has been suggested as an adjunct to overcome this deficiency. The continued effectiveness, emotional factors and group acceptance of mechanical toothbrushing was therefore studied in a group of 50 non-dentally orientated individuals. The brushes, 25 reciprocating action and 25 arcuate action, were distributed to patients following a clinical examination, questionnaire and prophylaxis. No instruction in the use of brush was given. Patients were evaluated at intervals up to 40 days when a second prophylaxis was performed and the type of brush changed. Patients were then followed for 40 more

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days. Initially a dramatic reduction in plaque was observed, with both brushes, in children and adults. This improvement in oral hygiene was transitory suggesting that once the novelty of the mechanical brush disappeared patients tend to return to old habits. The retention period, however, was significantly longer with the arcuate type brush."

KIMERY, M.J. and Stallard, R.E. The mechanical toothbrush: an effective adjunct to oral physiotherapy? I.A.D.R. Abstracts, 1968.

"The use of an automatic toothbrush by a group of 92 young women produced a highly significant reduction in gingivitis. This included 97 percent of subjects using automatic toothbrushes. The use of new, soft, nylon multi-tufted hand brush produced no significant reduction in total number of areas showing gingival inflammation...(93 young women in hand group)."

LOBENE, Ralph R. The effect of an automatic toothbrush on gingival health. J. Periodont. 35:137-139 Mar.-Apr. 1964.

"A group of 185 non-dentally oriented college age students were allowed the permissive use of either a short stroke, reciprocating action, powered toothbrush or a new soft nylon toothbrush, both purchased over the counter on the open market. At the end of a three months experiment, the powered toothbrush group showed a statistically significant reduction in gingivitis, whereas the hand toothbrush group showed no significant change in gingivitis between examinations. Thus the powered brush was superior in reducing and preventing gingivitis...."

LOBENE, Ralph R. Evaluation of altered gingival health from permissive powered toothbrushing. J.A.D.A. 69:585-588 Nov. 1964.

"Thirty subjects with periodontitis, 26 to 60 years old, assigned at random to control or experimental group. The control group continued to use their own method of home care. No instruction in toothbrushing or type of brush. ....Twelve week period.....The experimental group also showed a statistically significant reduction in gingivitis compared to control group. The experimental group also showed a statistically significant reduction in calculus compared to control group. No injury to the oral mucosa was observed or reported. Conclusion: The use of this automatic toothbrush may be of some therapeutic value in the treatment of patients with periodontitis.

LOBENE, Ralph R. The effect of an automatic toothbrush on periodontitis. J. Oral Therapeutics and Pharmacology 3:284-290 Jan. 1967.

Article describes method for measuring length of tuft, diameter of filament, wetness and temperature, effects of satisfactory design of toothbrushes. No specific brushing technique or brush recommended.

MacFARLANE, D.W. The dynamic stiffness of toothbrushes. J. Periodont. Res. 6:218-226, 1971.

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"It would appear from the results of this study that the electric toothbrush is equally as effective as the hand toothbrush when considered from the standpoint of gingival surface keratinization and tissue respiration. ( $QO_2$ )."

MANHOLD, John, Jr.; Franzetti, Joseph and Fitzsimmons, Leslie Effect of the electric toothbrush on human gingiva: Histologic and microrespirometer evaluation. J. Periodont. 36:135-140, Mar.-Apr. 1965.

Over a six week period, 84 subjects....(dental students and personnel) provided a total of 336 individual values...."Study appears to substantiate the results reported earlier of a reduction in the amount of calculus formation by the use of a power toothbrush.....The superior state of gingival health reported in favor of the power brush apparently is resultant from the superiority of cleansing action per se along with the cleansing action of an increased crevicular flow of fluid provided by the increased stimulation of the power brush. This conclusion is resultant from the fact that the power brushes do not provide any increase in the protective depth of the keratin layer of the gingival epithelium."

MANHOLD, J.H., Jr. Gingival tissue health with hand and power brushing: a retrospective with corroborative studies. J. Periodont. 38:23-29, Jan.-Feb. 1967.

"Since toothbrushing is essentially an abrading action, there is an optimum pressure and motion that will effectively clean the teeth, yet not cause structural damage when used over a long period of time. Purpose of this study was to measure the forces applied to the teeth when brushed normally with the various commercially available manual and electric brushes.....200 patients and eight combinations were tested. It was found that the brushing forces reached a maximum in the third decade and then showed some decline with increasing age. Also, the results of these tests indicate that generally more force is applied to the teeth with manual brushing than with electric brushing. A correlation of force and bristle stiffness was also noted. The forces measured were significantly higher than those previously reported."

McELHANEY, J.H. and Heiser, R.A. Toothbrushing forces. I.A.D.R. Abstracts 1965.

"There was no evidence that the electric brush was more effective than the hand brush in reducing oral debris, calculus formation or periodontal disease, or that one caused more recession than the other in dentally-oriented young adults"....103 subjects; ages 18 to 33; 87 male, 16 female. University students. Article has six tables.

McKENDRICK, A.J.W., Barbenel, L.M.H. and McHugh, W.D. A two-year comparison of hand and electric toothbrushes. J. Periodont. Res. 3:224-231, 1968.

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"The discarded brushes of 65 young adults, who took part in a clinical comparison of hand and electric toothbrushes, were used to assess the relationship between brush wear, and age of brush, Oral Debris Index and Periodontal Index.....These conclusions support an already common view, that we should not say to a patient: 'You should replace your brush every month/six weeks....' but rather should have a sample of a brush that is just ready to be discarded, and say, 'You should replace your brush when it begins to look like this.' We would then cover the odd occasions that a brush may last only one week or as long as six months. Nonetheless, it is quite clear that on average, a toothbrush lasts for a much shorter time than is commonly supposed. Although the mean age at discard was 10.5 weeks, most frequent age of discard was nine weeks and more than half the brushes were discarded by ten weeks.....Wear tended to be inversely related to age of brush. Neither brush age nor brush wear were related to Oral Debris Index or Periodontal Index."

McKENDRICK, A.J.W., McHugh, W.D., Barbenel, L.M.H. Toothbrush age and wear - an analysis. Brit. D. J. 130:66-68 Jan. 19, 1971.

Summary: "Forty-four subjects who had used an electric toothbrush for two years had their reactions to the brush assessed by means of a questionnaire. The largest majority (82%) liked the brush. The proportion of those who did not like the electric brush (18%) was very similar to the proportion among the control group who did not like the hand brush (15%). (55%) of electric brush users had some criticism of the brush of which the commonest were: not trouble-free (30%) and not efficient (28%)."

McKENDRICK, A.J.W., McHugh, W.D. and Barbenel, L.M.H. Patient reaction to an electric toothbrush. The Dental Practitioner 21:321-322 May 1971

Conclusions: "A total of 280 subjects participated in a clinical program using electric toothbrushes and 254 comparable subjects using hand toothbrushes in order to study the frequency and duration that each brushed his teeth. After a one year clinical evaluation, 149 subjects had discontinued the use of the electric toothbrush, while 39 reported they were not using the hand toothbrush. The brushing frequency of those using the electric increased from about 1.04 times a day to 2.90 times a day after two months and then steadily decreased in frequency thereafter. Those using the hand toothbrush did not appreciably change their brushing frequency throughout the one-year period."

MUHLER, Joseph C. Comparative frequency of use of the electric toothbrush and hand toothbrush. J. Periodontology-Periodontics 40:268-270 May 1969.

"Results of an examination are reported wherein 420 dental patients used several electrically driven toothbrushes, such as Broxodent, Vibradent and Novodont Acumatic. The average period between examination was three to four months. At the beginning and end of that period, the patients were

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examined for gingival health and plaque and calculus deposition. In addition, all subjects completed a questionnaire. No differences in the effectiveness of the different brushes could be observed. However, there was a marked improvement in gingival health, as well as a superior cleansing effect when electrically driven brushes were compared with conventional brushes. The patients did not state that the electrical toothbrush was faster than the conventional brush."

OHM, H. and Sonnabend, E. Electrically driven toothbrushes being practically tested. Dtsch. zahnarztl. Zschr. 22:1372-1378, Oct. 1967.

"The new mechanical toothbrush (Sona Stream Toothbrush) has been designed to provide a unique motion at the brush head which would produce the best cleaning and polishing of the teeth while beneficially stimulating the gingival tissue.....The brush was also designed specifically to maximize enamel polishing and cleaning while minimizing oral hard tissue abrasion and soft tissue trauma. The brush itself contains three rows of nylon bristles with two outer rows of bristles being eight mils. in diameter to maximize cleaning. The brush head is 7/8" in length and 3/8" in width. The inner rows consist of six tufts each containing 24 bristles. All bristles are 364 mils. in length.....In order to determine the influence of the experimental device upon oral hygiene, a pilot clinical study was undertaken. Total of 50 adults participated and were given a clinical examination for oral hygiene using procedures previously described. (The Greene and Vermillion Simplified Oral Hygiene Index) The subjects were stratified according to oral hygiene score at the initial examination and randomly assigned to one of two groups. All subjects were instructed to brush three times daily and were given either the experimental brush or a 22 tuft medium nylon bristle manual brush along with a generous supply of commercial dentifrice (Crest). After two months the subjects were again examined for oral hygiene. Throughout the study every possible precaution was taken to ensure the lack of knowledge of group assignment by the clinical examiner and the clinical personnel. The results after two months indicate a 74 percent superiority of the experimental mechanical toothbrush with regard to oral hygiene."

OSHIRO, R.S., Stookey, G.K, and Muhler, J.C. Laboratory and clinical studies concerning the development and evaluation of a new mechanical toothbrush. J. Periodont. 41:23-29 Jan. 1970.

"Patients find that the electric brush is easy to use as only placement of the brush has to be mastered, and by its use areas at the gingival margin left uncleansed by the ordinary methods of toothbrushing are kept clean if a brush of sufficient softness is used. A bristle diameter of 0.009 inches or 0.007 is recommended."

PARFITT, Gilbert J. Cleansing the subgingival space. J. Periodont. 34:133-139, Mar. 1963.



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"There are two types of therapeutic devices used at the present time in the prevention of oral disease: the powered toothbrush and the forced water jet. Both remove debris from the surfaces of the teeth. Subjective comparative clinical tests have shown that powered toothbrushes equal or surpass the efficiency of normal brushes in preventing and reducing gingival inflammation and the collection of calculus. The water jet devices appear to be a useful adjunct to other devices in cleaning between the teeth and in preventing gingival disease." (53 references)

PARFITT, Gilbert J. Therapeutic devices. Ann. N.Y. Acad. Sci. 153:360-372 Dec. 23, 1968. (Abstracted in Advances in Periodontics 1:38, 1970)

"Broxident electric brush compared to multitufted conventional hand brush with respect to removal of plaque from exposed tooth surface of 'open' interproximal spaces.....25 clinical patients evaluated weekly for four weeks on one of the brushes. Each patient was his own control using alternate brush for same period:....Results: Mean visit interproximal plaque score for entire month was lower for electric brush than hand brush. Difference significant at the 0.01 level of confidence. A comparison of plaque scores for buccal, middle, and lingual subdivisions of the interproximal tooth surface revealed a statistical superiority for the electric toothbrush."

POWERS, G.K.; Tussing, G.J.; Bradley, R.E. A comparison of effectiveness in interproximal plaque removal of an electric toothbrush and a conventional hand toothbrush. I.A.D.R. Abstracts, 1966.

"Conclusions: The suggestion is hereby made that toothbrushes be made to a new standard of 'hardness' so that those desiring 'extra-hard' may obtain a really stiff brush, and those who want a soft one may be accorded their choice. The bristles' diameter and lengths should be stated on the box and handle rather than described, ie, soft, medium, hard. A recommendation follows: extra hard, .015 inch by 1/2 inch; hard, .014 inch by 1/2 inch; medium, .013 inch by 1/2 inch or 5/8 inch; soft, .010 inch by 1/2 inch or 5/8 inch.....It must be remembered that the length of a bristle plays its part as well in the matter of flexion, and in the softer series of brushes, the filament could be a bit longer than in the harder brushes. Manufacturers should forget the words 'hard' and 'soft' and should print on the handles and boxes the diameters and lengths of the filaments, instead."

PUCKETT, John B. Bristles in hand manipulated toothbrushes. J. Periodont. 41:398-400 July 1970.

"Under the conditions of these experiments, which include oral hygiene-conscious subjects (50), long brushing times, and massive accumulations of dental plaque, the reciprocating motion electric toothbrush was as

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effective at removal of dental plaque as a two-row, medium hard, nylon toothbrush and superior to an arcuate motion electric toothbrush."

QUIGLEY, Gertrude A., and Hein, John W. Comparative cleansing efficiency of manual and power brushing. J.A.D.A. 65:26-29, July, 1962.

"The automatic toothbrush (G.E.) and the hard, natural bristle toothbrush (Lactona)(#12) are: 1) equally effective in the prevention of plaque and calculus, and 2) have an equal effect on gingivitis, periodontal disease index, and the depth of the gingival crevice."

RAINEY, Bernard L. and Ash, M.M., Jr. A clinical study of a short stroke reciprocating action electric toothbrush. J. Periodont. 35:455-462 Nov.-Dec. 1964.

"Sixty year old male patient had good hygiene on the labial surfaces, but poor on lingual surfaces. A reciprocal-stroke motorized brush was suggested for improving oral hygiene in these areas. After one year observation it was noted that the cervical dentin on buccal of lower left first molar was markedly abraded due to horizontal brushing action of the motorized brush. In the light of the modern concept of dentin as a living cellular tissue, we cannot look upon this hard structure as an inert substance which can safely be abused by the indiscriminate use of high speed cutting instruments or even by motorized toothbrushes. It would be prudent for the dentist who observes cervical abrasions in his patients' teeth to caution them against horizontal brushing, especially if a motorized toothbrush is used.

ROTH, H. A case report of tooth abrasion associated with mechanical brushing. J.A.D.A. 73:120-123, July, 1966.

"Hand toothbrushing three times a day does not significantly reduce calculus formation on the lingual surfaces of the mandibular incisors over a period of one month, when compared to not brushing at all. Brushing with the automatic toothbrush three times a day over a one month period significantly reduces the amount of calculus formation when compared with handbrushing and not brushing at all." (33 rapid calculus formers-dental students 26 years average were subjects.)

SANDERS, Wm. E. and Robinson, H.B.G. Effect of toothbrushing on deposition of calculus. J. Periodont. 33:386-390 Oct. 1962.

"Modern technology developed the sophisticated electric toothbrush. This new device will brush teeth more effectively, one assumes, due to the increased number of strokes per minute. The type of dentifrice used is also important, and the type of abrasive used in the dentifrice may be

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particularly important. Abrasiveness level is measured by the application of Grabenstetter's radiotracer dentin abrasiveness test. One of the conventional electric brushes and a manual brushing simulator device were compared using calcium phosphates exhibiting different abrasiveness.  $P_{32}$  uptake of slurries containing the different abrasives were compared after five minutes brushing of irradiated dentin surfaces. Several teeth were used to eliminate possible bias. The electric toothbrush was proven to be less abrasive and relative abrasiveness reduction increased with increased level of abrasiveness."

SCHIFF, T. Abrasive characteristics of materials of different degree of abrasiveness in a comparative study between electric and simulated manual brushing. I.A.D.R. Abstracts, 1965.

"Thirty-two dental students, nine female and 23 male subjects were scaled and polished, testing with basic fuchsin disclosing solution, new brushes distributed at random after 24 hours of no brushing, Gibbs SR toothpaste provided, and asked to brush in usual manner. Six days later brushes collected, plaque scored using Bay's modification of Quigley and Hein's Index.....The hard-textured short-headed multitufted Gibbs brush used in this trial appears significantly better at plaque removal than the Gibbs short-and-long-headed multitufted medium brushes, and the Gibbs long-head hard multitufted brush. Other factors such as reduction in gingivitis or calculus formation, trauma, etc. were not measured. During the limited period of the trial, no untoward effects of a hard brush were noted."

SCULLY, C.M. and Wade, A. Bryan. The relative plaque-removing effect of brushes of different length and texture. Dent. Practit. 20:244-248 March 1970.

(Eighty junior dental students divided into four groups as nearly alike as possible. Twelve week study).."The instructions with a new toothbrush appear to be of greater importance for removing or preventing dental plaque than the use of a particular type of toothbrush or method of brushing."

SHICK, Richard A. and Ash, Major M., Jr. Evaluation of the vertical method of toothbrushing. J. Periodont. 32:346-353 Oct. 1961.

"Program of toothbrushing involving 270 nondentally oriented young adults. The use of a short stroke, reciprocating action, automatic toothbrush, as compared with the hand toothbrush was appreciably more effective in reducing gingivitis, in maintaining the health of the gingiva and in the prevention of new lesions in the anterior region of the mouth. None of the severe gingivitis lesions was cured completely in the hand toothbrush groups, whereas 12.5 percent of severe gingivitis lesions in the automatic brush group was cured."

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SOPARKAR, Paramod M. and Quigley, Gertrude, A. Power versus hand brushing: effect on gingivitis. J.A.D.A. 68:182-187, Feb. 1964.

"Three hundred fourteen non-dentally oriented women college students were divided at random into two groups: a control group which was given a new hand brush, similar to one they were currently using and an experimental group which was given a G.E. automatic brush with a 0.012 inch brush insert. New hand brushes and brush inserts were issued every three months. The subjects were given no brushing instructions. A total mouth PMA type gingival examination and partial mouth supra-gingival calculus examination were performed at outset and at end of one year. Following initial examination, subjects received oral prophylaxis. At the end of the year the G.E. group of 140 subjects showed a statistically significant betterment of both papillary and marginal gingival health in comparison to the control group of 134 subjects using 85 Pycopay medium, 42 Pycopay hard and seven Oral-B hand brushes. There was no difference in the amount of supragingival calculus. This work suggests that novelty does not explain the previously reported benefits of the electric toothbrush on gingival health."

SOPARKAR, P.M., Quigley, G.A. and Hein, J.W. One year clinical gingivitis and calculus trial comparing an electric and hand toothbrushes. I.A.D.R. Abstracts, 1965.

"Five powered toothbrushing motions were studied by stroboscope, and still and high-speed moving pictures to aid in evaluating the clinical significance previously reported on safety, cleaning effectiveness, and healthful action. Brushing forces of 50, 100 and 200 grams were applied to 60 durometer rubber dentiform used for simulating oral tissues..... Results: Bristle tips of short stroke reciprocating action brush were observed to remain motionless on simulated gingival surfaces, to move along the gingival sulcus line, and to enter interproximally to a greater degree with increased forces and smaller bristle diameters. Movement across teeth was not greatly affected by changes of force or bristle diameter. Bristle tips of orbital action and cyclically modulated short stroke reciprocating action brushes were observed to move over the gingiva with little tendency to remain motionless, but moving sporadically across the teeth, gingival sulcus and interproximally, generally independent of brushing forces and bristle stiffnesses studied. Arcuate action brush with tufts all the same length were observed to have a localized high pressure rocking effect on simulated gingival surfaces, which increased as forces increased and as bristle diameter decreased. Brushes with one longer central than outer two rows of tufts, sweep over gingiva and teeth independent of forces and bristle diameter. Bristle tips pushed deeper into gingival sulcus and interproximal spaces with smaller diameter bristles and increased forces. ....Rotary action powered toothbrush bristles push into or draw away from the gingival margin depending upon direction of rotation....Bristle

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tips of vibratory action brush spasmodically impinge upon surfaces, and to a greater degree with increased forces."

TERRY, Ira A., Springer, H., Harrington, J.H. Powered toothbrush bristle motion on simulated gingivae and teeth. I.A.D.R. Abstracts, 1965.

"An electric toothbrush (Broxodent) was used in home care of ten periodontal patients for six weeks. Ten patients with same condition served as controls and used conventional brushes. All twenty were treated routinely by root planing and were seen weekly. Effectiveness evaluated by relative freedom from deposits and materia alba and improvement in gingival color and stippling. Results for both groups parallel, except after fourth week the improvement in gingival stippling was more marked in group using electric. Result appears to be related to greater effectiveness of electric in gingival massage."

TOTO, Patrick D., and Farchione, Alfred Clinical evaluation of an electrically powered toothbrush in home periodontal therapy. J. Periodont. 32:249-254 July, 1961.

"A study was undertaken to determine the relative effectiveness of an electric powered toothbrush and a manual toothbrush, the role of instruction in the proper use of the brush in the cleaning of teeth, and to demonstrate any therapeutic effect of toothbrushing, per se. Subjects were 372 boys and girls of school age who lived and attended school in a carefully supervised academy. The experimental group were arbitrarily issued either an electric or manual brush and received formal instructions in the use of either type. Children instructed to brush in a sweeping motion from the gingival margin over the tooth surface to the occlusal surface. In order to standardize the brushes, the brush heads on both electric and manual were identically constructed. A non-therapeutic dentifrice containing a detergent, packaged in unmarked tubes, was made available. A control group of 451 school aged children were selected on the basis only of their use of manual toothbrush and a dentifrice of their own choosing. The examiners and the school administration were careful not to suggest to these children they were participants in an experiment. The children were carefully examined and data collected on the number of decayed, missing and filled teeth (DMF) and the oral debris index (ODI).....The children were examined every six months for 18 months. The results of the study indicate that the decrease in DMF which was seen after both the use of the manual and the cordless electric toothbrush following instruction was significantly greater than that noted in the case of uninstructed toothbrushes. Electric toothbrushes, per se., were found to be no better in decreasing DMF and ODI than were manual brushes. The reduction in DMF as seen from electric toothbrushes over a period of two years was 24 percent. As in the uninstructed group, the DMF reduction was only ten percent. The cordless electric toothbrushes showed a ten percent greater reduction in DMF than appeared among uninstructed

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manual brushes. It was concluded that if clean teeth are to be considered beneficial to the oral health, only careful instruction in toothbrushing can assure the acquisition of clean teeth."

TOTO, P.; Sawinski, V. and Evans, C. The effects of instructed tooth brushing on the cleanliness of teeth and DMF: and 18 month study. J. Oral Therp. and Pharmacol. 3:354-358, Mar. 1967.

## VII. FLUORIDES

"Clinical study conducted to evaluate effectiveness of a stable 30 percent stannous fluoride solution on recurrent dental caries around the margins of amalgam restorations. Two hundred ninety deciduous and permanent teeth involving 584 surfaces were restored in 34 children, six to nine years of age. Cavity preparations were treated with either a stable 30 percent stannous fluoride solution or a placebo solution, (double blind technique) prior to the placement of amalgam restorations. A comprehensive code system was used to record the description and position of conditions associated with recurrent caries after a one year period. Children receiving stannous fluoride treatment experienced a 61.2 percent reduction in recurrent dental caries in the mixed dentition when compared to that of controls. Children receiving stannous fluoride showed 61.8 and 50 percent reductions in recurrent carious lesions in permanent and deciduous teeth, respectively. Reduction attributed to the anticariogenic effect of the stannous fluoride treatment."

ALEXANDER, William E.; McDonald, Ralph E. and Stookey, George K. Effectiveness of a stable 30 percent stannous fluoride solution in the prevention of recurrent dental caries. J. Indiana D. Assn. 48:174-180 Apr. 1969.

"The unnatural and unjudicious use of fluoridation, which is ineffective against dental caries and which is dangerous for the health and well being, should as soon as possible be replaced by complete tooth nutrition which is a natural, wholly beneficial and wholly effective means of growing teeth that are immune against dental caries."

ASHLANDER, Alfred. Fluoridation from the nutritional point of view. Pakistan Dental Review XVI: No. 3 July 1966.

"Radiological findings of a double-blind, controlled clinical trial to test the efficacy of stannous fluoride and sodium monofluorophosphate containing toothpastes when used unsupervised over a period of three years by eleven and 14 year old male and female London school children. From annual bitewing films of posterior teeth exposed and processed under standard conditions, caries increments were determined for mesial and distal surfaces of molar and premolar teeth. Results show that both stannous fluoride and sodium monofluorophosphate containing pastes caused significant reductions in caries increments when compared with the control paste. These reductions were greater on radiographic evidence alone than when radiographic and clinical findings were combined. The distal surfaces of the first permanent molars appeared to respond as newly erupted surfaces with considerable reduction in caries increment."

ASHLEY, F. P.; Naylor, M.N. and Emslie, R.D. Stannous fluoride and sodium monofluorophosphate dentifrices. Brit. D.J. 127:125 Aug. 5, 1969.

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"Prior to the start of the present investigation, 578 children in the ten to twelve age group in a suburban area near Copenhagen had participated in a 30 month investigation of caries-inhibiting effect of a dentifrice containing sodium monofluorophosphate. At the end of this 30 month study a group of 172 children, selected at random, were examined for incidence of plaque and gingivitis. At this point, the supervised toothbrushing at school ceased, as did the supplying of dentifrice to the families. One year later (i.e. 42 months after the start of the basic experiment) the children were re-examined. The results of the investigation led to the following conclusions. 1) incidence of plaque and gingivitis was identical in the fluoride group and control group at both first and second examination. This suggests that using a dentifrice containing sodium monofluorophosphate - up to three times a day - for 30 months does not increase the incidence of plaque or gingivitis in children. 2) At the time of the second examination (one year later) a significant increase in Plaque Index and gingival Index scores occurred ( $P < 0.05$ ), presumably because the children now no longer brushed their teeth under supervision."

BAY, I. and Moller, I.J. The effect of a sodium monofluorophosphate dentifrice on the gingiva. J. Periodont. 3:103-108, 1968.

".....In this investigation the children themselves performed the application under the supervision of their school dental officer by brushing their teeth with a solution containing one percent of sodium fluoride. Comparison between the treated group and the control group revealed a significant difference as regards the incidence of caries. The inhibiting effect was especially pronounced in teeth which had erupted during the application period. The difference was statistically significant in regard to maxillary teeth while in mandibular teeth it was not quite as definite, no difference being found at all in respect to some individual teeth. A comparison between the two groups with respect to the caries status of tooth surfaces revealed fairly great variations. The cause of this may lie in the fact that brushing is more effective on some surfaces than on others. The magnitude of the caries inhibiting effect was calculated on the results of the sodium fluoride application on maxillary teeth and was found to vary considerably in different teeth. The mean reduction of caries was calculated to be between 25 and 30 percent."

BERGGREN, Helge and Welanders, Erik. Supervised tooth brushing with a sodium fluoride solution in 5,000 Swedish school children. Acta Odontologica Scandinavica 18:209-234 Nov. 1960.

"It is a low estimate that 110 million people in 32 countries are drinking fluoridated water.....foreign research has shown that fluoridation prevents those cavities which are most difficult to treat, i.e., proximal lesions. Interestingly, a Russian study demonstrated not only the safety



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of water fluoridation, but also a beneficial effect on bone.....Countries leading in water fluoridation outside of the United States: USSR 13.0 million, Canada 0.6 million; Australia 4.0 million; Hongkong 3.57 million; Chile 3.7 million; Columbia 2.4 million; The Netherlands 2.5 million; United Kingdom 2.25 million; Ireland 1.25 million."

BERNHARDT, Mary E. Fluoridation international. Quintessence International 2:81 Jan. 1971.

"The arrestment of carious lesions and the prevention of new lesions by the use of fluoride solutions could provide a two-pronged offensive against dental caries. Acidulated phosphate fluoride provides high concentrations of fluoride in the surface layers of enamel. Stannous fluoride provides for arrestment of already existing lesions, some remineralization of partially decalcified tooth structure and some protection against new lesions. The best use of these solutions indicates that both should be used for the best protection for patients who have previous caries experience. By using stannous fluoride and acidulated phosphate fluoride, together, we may provide prevention, arrestment and some remineralization of carious lesions."

BINNS, Jr., Wm. H. A double barreled approach to topical fluoride therapy. Pennsylvania D.J. 36:45-47 Feb. 1969.

"One sample of soft deposit was taken from each of 143 eleven to thirteen year old children performing weekly mouth rinses with ten ml. 0.2 percent NaF or 0.2 percent NaCl. Fluoride was determined and the ppm fluoride calculated on the dry weight basis. The mean ppm Fluoride was  $55 \pm 53$ . Fluoride decreased with increased weight of samples. Neither fluoride, toothbrushing before rinsing, nor sex had any significant effect on fluoride in plaque samples collected four to five days after the last rinsing. In a previous series comprising 57 children, the ppm fluoride was elevated about one day after NaF rinses. The effect of fluoride in plaque is discussed with respect to gingivitis and caries."

BIRKELAND, J.M.; Jorkjend, L. and Von der Fehr, F.R. The influence of fluoride rinses on the fluoride content of dental plaque in children. Caries Res. 5:169-179, 1971.

"The parameters examined included: concentration of fluoride, frequency of application of fluoride, age of animal, duration of study and extent of lesion formation. The anticaries efficacy of fluoride ( $\text{SnF}_2$  or NaF) was significantly increased as the concentration of fluoride and the frequency of application were increased. No consistent superiority was found for one compound ( $\text{SnF}_2$  versus NaF) over the experimental conditions studied. The age of the animal, duration of study and extent of lesion formation did not significantly alter the relative efficacies of  $\text{SnF}_2$  and NaF."

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BRINER, W.W. and Francis, M.D. Comparison of the anticaries effects in rats of NaF and SnF<sub>2</sub> applied topically under a wide variety of experimental conditions. Caries Res. 5:180-187, 1971.

"Studies by NIDR grantees at Boston's Forsyth Dental Center show that topical applications of fluoride are more effective if enamel is pre-treated. Authors report that more fluoride is incorporated into enamel by topical application if the teeth are first treated for one minute with dilute phosphoric acid or with a solution of an aluminum or titanium salt (Al (NO<sub>3</sub>)<sub>3</sub> or TiCl<sub>4</sub>). These pretreatments should increase protection against tooth decay because resistance to decay apparently increases as the amount of fluoride remaining permanently bound in the tooth structure increases. In the Forsyth studies, a three minute local application of a 1.2 percent acidulated fluoride solution raised fluoride levels in the outermost layer of enamel from 400 parts per million(ppm) to 800 ppm. When a cotton pellet soaked in 0.01 M phosphoric acid was placed on the tooth for one minute before the fluoride application, the fluoride level increased to some 850 to 1100 ppm. These figures doubled or tripled when an 0.05M solution of the acid was used. Pre-treatment for one minute with a 0.05M solution of Al(NO<sub>3</sub>)<sub>3</sub> raised the figure to 3700 ppm, while a 0.05M solution of TiCl<sub>4</sub> raised the fluoride level even higher."

BRUDEVOLD, F.; Aasenden, R.; Gron, P. and McCann, H.G. Topical fluoride treatments improved. Midwestern Dentist 45:21 May, 1969.

"Fluoride concentrations in the surface enamel of intact maxillary anterior teeth of 90 adults from a military base were determined in situ by means of a newly developed biopsy method. The teeth were then given different topical fluoride treatments, and levels of fluoride were determined again five to eight weeks later by taking another series of biopsies. Three fluoride solutions were used, all containing 1.2 percent fluoride and 0.1M H<sub>3</sub>PO<sub>4</sub> but having pH levels of 3.2, 4.3 and 7.0. Each fluoride solution was used alone for three minutes or combined with one minute pre-treatment which involved mild etching of the enamel with 0.01 or 0.05M H<sub>3</sub>PO<sub>4</sub>. Statistically significant amounts of fluoride were deposited from all fluoride treatments. Pretreatment with H<sub>3</sub>PO<sub>4</sub> increased fluoride deposition, particularly from the low pH fluoride solutions. Greatest amounts of fluoride were deposited in enamel treated with 0.05M H<sub>3</sub>PO<sub>4</sub> followed by application with the fluoride solution at pH 3.2 or 4.3. No detrimental effects were observed from these treatments. The merits of the biopsy method and the experimental design of the study are discussed."

BRUDEVOLD, F.; Aasenden, R; McCann, H.G. III; and McCann, H.G. Use of an enamel biopsy method for determination of in vivo uptake of fluoride from topical treatments. Caries Res. 3:119-133 1969.

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"The caries-experience of 103 elementary school children, ages eight to twelve years, has been reported after application of acidulated phosphate-fluoride gel in foam-rubber trays. Two years later these children experienced 44.6 percent fewer increments of DMFT and 37.2 percent fewer increments of DMFS than the 105 similar children who served as controls."

BRYAN, Eugene T. and Williams J. Earl. The cariostatic effectiveness of a phosphate-fluoride gel administered annually to school children; final results. J. Public Health Dentistry 30:13-16 Winter, 1970.

"A community is fortunate when it can drink fluoridated water and develop a reduction in new carious lesions of 66.6 percent." quote reference: Arnold, F.A, Dean, T.T. and Knutson, J.W. Effects of fluoridated water supplies on dental caries prevalence. Seventh year of Grand Rapids - Muskegon Study, p. 200-206 (In McClure, F.J. ed. Fluoride drinking waters. Washington, Government Printing Office, 1962. VI and 636 p.)

CLARK, Charles A. and Fintz, James B. ....and the children shall lead them. J. Am. Soc. Preventive Dent. 1:26-29 July-Aug. 1971.

"Subsequent to the initial examinations, based on pairing, 1,276 Grade VII students were divided in two groups. All of participants brushed their teeth under supervision nine times over a period of two years. The experimental group brushed with a solution of fluoride-phosphate and the controls brushed with a placebo. In a double-blind study, all students examined annually. At the end of three years, 915 subjects still available for examination. The experimental group experienced 25 percent fewer new carious surfaces than the controls."

CONCHIE, J.M.; McCombie, F. and Hole, L. W. Three years of supervised toothbrushing with a fluoride-phosphate solution. J. Public Health Dent. 29:11-18 Winter, 1969.

"This study clearly suggests that enamel solubility is influenced by enamel fluoride concentrations and that the relationship is an inverse one. In no previous studies have correlations between surface enamel solubility and fluoride levels been demonstrated directly. The data of Isaac, Brudevold, Smith and Gardner on powdered enamel pointed to such a relationship and in three other studies (Jenkins, G.N, Healy, W.B. and Finn, S.B.) comparison of enamel from fluoridated and low-fluoride areas showed a similar tendency."

CUTRESS, T.W. and Malthus, R.S. The fluoride concentrations and acid solubility of teeth from fluoridated (lppm) and low-fluoride areas. New Zealand D. J. 66:229-234 July 1970.

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"This is an eight year, serial clinical experience in an artificially fluoridated area, four years before and four years after a single annual topical application of acidulated phosphate fluoride with a previous prophylaxis. (200 student residents at the Illinois Braille and Sight Saving School) The caries susceptible students in 1961 to 1964 had a mean DMFS of 2.67 and, after the topical application of phosphate fluoride 1965 to 1968, a mean DMFS of 1.73, a reduction of 35 percent. The data tends to indicate that these students, having had a high incidence of caries, received less benefit from the topical application of phosphate fluoride. In their clinical records it had been noted that these students had had consistently poor oral hygiene. Wellock, Maitland and Brudevold in 1965 contend that the success of applications of topical fluoride treatment is dependent on the status of oral hygiene. My clinical records over an eight year period indicate that this is indeed a fact."

DAVIS, Robert Lee Caries reduction in a single annual topical application of acidulated phosphate fluoride. Ill. D.J. 39:98-102 Feb. 1970.

"....The best way to improve the Nation's dental health is to prevent dental disease. Dental caries, periodontal disease and oral cancer can largely be prevented but we have failed to apply fully the scientific knowledge we have. Fluoridation prevents tooth decay by more than two-thirds; it is so safe, economical and simple to implement, it has been called an ideal public health measure. Yet after 50 years of research and 25 years of practical experience we find that more than 12,000 communities still have not started fluoridation programs. Fluoridation is a major health economy; it actually cuts the costs of treating tooth decay in half.....only half of the people in the United States receive fluoridation benefits.....For those children who do not have access to a community water system, the fluoridation of school water supplies can be substituted, or the use of self administered topical fluorides, such as mouthrinses and special fluoride pumice pastes....."

DIEFENBACH, Viron. The dental plaque. J. Am. Soc. Preventive Dentistry 1:12,30 Oct. 1970.

".....studies have provided consistent evidence that, in addition to all food and ambient sources of fluoride, humans may daily ingest water having up to at least eight times the amount of fluoride provided by optimally fluoridated water without adverse effect other than mottling of tooth enamel. Mottling, however, does not result from the use of optimally fluoridated water."

DIEFENBACH, Viron L. Community water fluoridation and total fluoride intake. The Arizona D.J. 17:19-20 July- Aug. 1971. (Excerpt from testimony of V.L.Diefenbach, DDS, Asst. Surgeon General, at hearings before a subcommittee of the Committee on Appropriations, House of Representatives, 91st Congress, Second Session, 1970)

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"From the references given (in article) it will be clear that fluorosis may be caused by drinking water containing the recommended quantity of one ppm fluorine, and that severe cases have arisen from water supplies ranging up to five to six ppm. It may be concluded that the 'no-effects level' is under one ppm. It seems impossible to reconcile fluoridation of drinking water, man's most important nutrient, with the generally recommended and accepted practice that food additives should not be permitted at levels exceeding one percent of the no-effects level."

DOUGLAS (Lord Douglas of Barloch) World Health Organizations and fluoridation. Pakistan Dental Review XX:50-53 Apr. 1970.

"The first water fluoridation projects were initiated in 1945 in American and Canadian cities.....On the whole, it is estimated that 110 million persons in 32 nations enjoy the benefits of fluoridated water.....The caries preventive effect of fluorides was not a laboratory discovery; rather, it was deduced from epidemiological studies.....the precise mechanism of fluoride was learned only via a long detour: a thorough study of the problem of mottled enamel.....Tooth mottling occurs only when the fluoride concentration in drinking water exceeds 1.5 mg/L. The protective effect of fluoride against caries, however, appears much sooner, and is at an optimal level in the range one to 1.25 mg/L....(Article describes problems 25 years ago with antifluoridationists and concludes with the time and cost factors to provide regular, periodic dental care for children in fluoridated and non-fluoridated areas.)....The results, briefly stated, are: The costs of regular dental care of children, so that no permanent tooth required extraction, were less than half in fluoridated Newburgh when compared to non-fluoridated Kingston. Furthermore, less time was required for dental treatment in Newburgh than in Kingston."

DRUM, Walter. Caries prophylaxis with fluorides - 25 years' experience. Quintessence International.J. Practical Dent. 2:85-88 Mar. 1971.

"Plaque from subjects graded for caries experience living in two cities, the water of one of which was fluoridated during the experiment, was allowed to form acid from sucrose. The mean pH value reached after 15 minutes was the same in plaque from the two cities before fluoridation, but was higher than in control plaque when the subjects received fluoridated water. The significance of the results is discussed in the context of the mode of action of fluoride."

EDGAR, W.M.; Jenkins, G.N. and Tatevossian, A. The inhibitory action of fluoride on plaque bacteria. Brit. D.J. 128:129-132 Feb. 3, 1970.

"The residual anticaries effect of repeated, self-applied topical applications of water-soluble gels containing 1.1 percent NaF in mouthpieces

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were assessed in 379 children, initially eleven to 14 years of age, living in fluoride-deficient Cheektowaga, N.Y. The data from this study shows that children who had received at least 200 daily topical treatments with either an acidulated NaF phosphate or plain NaF gel over a period of 21 months, continued to have significantly lower dental caries increments 23 months after the treatments had been discontinued, than were found in an untreated control group. An analysis of the fluoride concentration of exfoliated deciduous teeth collected during the post-treatment period showed high residual fluoride concentrations remaining in the four outer layers of enamel. Neither the clinical caries data nor the enamel fluoride concentration of the deciduous teeth showed evidence of a reduction in the magnitude of the protective effect during the 23 month post-treatment period."

ENGLANDER, Harold R.; Carlos, James P; Senning, Rickley S. and Melberg, James R. Residual anticaries effect of repeated topical sodium fluoride applications by mouth pieces. J.A.D.A. 78:783-787 Apr. 1969.

"Fluoride retention from mouthrinses and dentifrices was studied in three to seven year old children. Below three years control over swallowing reflexes was found to be inadequate. For mouthrinses by children between three and seven years a volume of seven ml and a time of 30 to 60 seconds were found suitable. In such mouthrinses by four to seven year old children, using a 0.054 percent NaF solution the fluoride retention was found to be 21.4 to 24.4 percent, S.E. 1.5 to 2.4 percent; with three to four year old children the corresponding figures were  $25.8 \pm 4.9$  percent. In toothbrushing tests with four and six year old children using 0.4 to 0.5 g portions of two different toothpastes containing about 0.1 percent fluoride, the retention was found to be  $26.1 \pm 2.01$  and  $33.2 \pm 5.35$  percent respectively, in the younger children, and  $24.5 \pm 1.56$  and  $28.0 \pm 2.16$  percent in the older children."

ERICSSON, Yngve and Forsman, Britta. Fluoride retained from mouthrinses and dentifrices in preschool children. Caries Res. 3:290-299, 1969.

"A double-blind study has been conducted in which a large sample of high-school children used stannous fluoride and sodium monofluorophosphate dentifrices and a control over a period of two years. Findings show that the two fluoride dentifrices, when compared with the control, resulted on the average in approximately 27 percent fewer new decayed tooth surfaces during the second year, and 21 percent fewer cavities over the second year period. At the commencement of the trial all subjects in the three groups exhibited the same amount of calculus, stain and gingival inflammation. Between routine examinations two and four there was an increase in the indices of these three conditions. The increases were similar for the calculus and gingival inflammations for the three groups, but the stain increased significantly in the stannous fluoride group.

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.....Notwithstanding the favorable findings of this study, it seems important to stress the value of the cumulative benefits of other established methods of caries prevention such as dietary control, water fluoridation, and regular dental care."

FANNING, E.A.; Gotjamanos, T. and Vowles, N.J. Fluoride dentifrices: A clinical trial. Aust. D.J. 13:201, 1968.

"The relative increment of decay in a group of children, six to 14 years of age, who used a six percent solution of sodium monofluorophosphate on their toothbrushes daily for 21 months was 51.1 percent lower than in a control group. The increase in decayed and filled surfaces (DFS) was also 52.3 percent lower, and the children using the fluoride compound had 66 percent more reversals. The test was conducted in an area supplied with fluoridated water."

GOAZ, Paul W.; McElwaine, Lawrence P.; Biswell, Helen A. and White, Wayne E. Anticariogenic effect of a sodium monofluorophosphate solution in children after 21 months of use. J.D. Res. 45:286-290 Mar.-Apr. 1966.

(580 children examined. 14 months later, 476 children available.).. "A small reduction in new DMF of seven to eleven year old children was found after the supervised self-application of stannous fluoride-zirconium silicate paste. Reduction observed was too small to be statistically significant."

GUNZ, Gertrude M. The effect of self-applied fluoride paste. J. Public Health Dentistry 31:177-181 Summer 1971.

This review of the literature on therapeutic dentifrices includes 67 references appraised....."The compounds which have attracted the most attention thus far are sodium fluoride, stannous fluoride, sodium monofluorophosphate, acid phosphate-fluoride and amine fluoride. Sodium fluoride was the first agent with fluoride to be incorporated in a conventional toothpaste. Initial clinical studies with dentifrices containing sodium fluoride, however, failed to elicit a significant reduction in dental caries-activity among most participants who used them. There followed numerous studies with a dentifrice containing stannous fluoride-calcium pyrophosphate (Crest). Data on effectiveness generally have been consistent, although some of the differences in incremental scores for caries-activity between the tested group and its controls have not been found statistically significant. Notable differences can be found in the design of these studies, particularly in regard to the frequency of brushing, extent of instruction in brushing, supervision provided for participants, and age of subjects....."It has been hypothesized that dentifrices containing stannous fluoride have been successful and the initially developed dentifrices containing sodium flu-

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oride were not because those with stannous fluoride have a more compatible abrasive quality and lower values for pH. The increased acidity tends to favor the deposition of fluoride in enamel. Support for this hypothesis is provided by the findings of recent clinical studies with a dentifrice containing sodium fluoride, orthophosphoric acid, and a calcium-free abrasive of insoluble sodium metaphosphate. Children brushing with this dentifrice experienced significantly less new lesions than the subjects used as controls. It appears, however, that a dentifrice containing sodium fluoride and a compatible abrasive but lacking a low pH also can be effective in reducing incremental decay, as shown by the findings in a two year clinical test in Sweden. Although these reports of newer dentifrices containing sodium-fluoride are encouraging, meaningful evaluation of these products must await the completion of more studies.....Investigators in Switzerland have conducted experiments in vitro which indicate that organic amine-fluorides may be better than inorganic fluorides in protecting enamel from decalcification by acid. The results of studies in animals show that it is possible to incorporate amine-fluorides into dentifrices without loss of cariostatic activity. Initial clinical findings suggest that long-term inhibition of dental decay can be obtained from the unsupervised use of the dentifrice. Further investigation is indicated."

HEIFETZ, Stanley B. and Horowitz, Herschel S. An appraisal of therapeutic dentifrices. J. Public Health Dentistry 30:206-211 Fall Issue, 1970.

"One thousand forty-three children in grades seven and eight began a three year study to determine the efficacy of self-administered toothbrushing with acidulated phosphate-fluoride (APF). On the basis of sex, age and previous caries-experience, children were separated in four comparable study-groups. Group A (controls) brushed with a standard prophylaxis paste and immediately following, brushed with a placebo-solution; Group B brushed with the prophylaxis paste followed by a 0.6 percent APF solution; Group C brushed with the 0.6 percent APF solution and utilized no prior toothbrushing with the prophylaxis paste; and Group D brushed with the paste followed by a 1.23 percent APF gel. The agent was applied at school under lay supervision at frequency of five times a school year. Only 568 participants completed two years of study and were available for both follow-up examinations. For these children, after both one and two years of study, mean incremental scores for DMF teeth and surfaces in all test-groups were similar to those of controls. All observed differences were inconsequential and could easily have occurred by chance. Because none of the procedures by toothbrushing demonstrated any caries-preventive benefits and because of the large attrition of subjects, the study was discontinued after the second year."

HEIFETZ, Stanley B.; Horowitz, Herschel S. and Driscoll, William S. Two-year evaluation of a self-administered procedure for the topical application of acidulated phosphate-fluoride; final report. J. Public Health Dent. 30:7-12 Winter Issue 1970.



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"Briefly summarized, this paper reports selected literature that demonstrates the safety of fluoridated water. Its safety is supported by a review of carefully planned studies of the effects of fluoridation on 1) arthritis, 2) cancer and cardiovascular-renal diseases, 3) hypertension, 4) bone, 5) kidneys, 6) periodontium, 7) fetus, 8) fluorosis, and 9) health. A listing of the professional organizations that have approved fluoridation is supplied.....This review permits one to conclude that scientific inquiry and research has shown that there is no danger to the health of people when the fluoride added to drinking water is consumed in the proportion that is necessary for the prevention of dental caries activity; and no adverse effect has been demonstrated on the health of the people who are living in areas where the drinking water contains natural fluorides."

HEISE, A. Lee The safety of fluoridation. J. Kentucky Dent. Assn. 22:19-23 Oct. 1970.

"Tracer studies of fluorine retention and excretion after sodium fluoride mouth-washes have shown significant retention of the fluoride. Only a small fraction of the amount of fluorine retained at mouthwashing was recovered in the urine within four hours. The uptake of fluorine in teeth in vivo showed a statistically probable difference between wax-covered and uncovered tooth crowns. The influence of 0.1 percent sodium fluoride mouthwash on the formation of lactic acid following ingestion of sucrose was studied. A reduction of the formation of lactic acid, limited to the first ten to fifteen minutes was observed."

HELLSTROM, Ingrid. Fluorine retention following sodium fluoride mouth-washing. Acta Odontologica Scand. 18:263-278 Nov. 1960.

(436 children, birth to five and one-half years)..."Experimental group received a fluoride-vitamin supplement containing vitamins A,C, and D and 0.5 mg. fluoride (as NaF) between ages of zero to five months, a more complete vitamin supplement 0.5 mg. fluoride (as NaF) between the ages of twelve and 24 months, and a vitamin-fluoride chewable tablet containing 1.0 mg. fluoride (as NaF) after two years of age. The control group received some without added fluoride. Reduction in dental caries prevalence of about 55 percent in teeth and 63 percent in surfaces for the primary teeth. Results indicate fluoride-vitamin supplements provide an effective method of supplying fluoride where fluoride cannot be obtained in communal water supply."

HENNON, David K.; Stookey, George K. and Muhler, Joseph C. The clinical anticariogenic effectiveness of supplementary fluoride - vitamin preparations. Results at the end of three years. J. D. Children 33:3-12 Jan. 1966.

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One thousand six hundred and ninety-one children (5 to 13 years old) were examined that had lived in Lower Hutt ten years (1959 to 1969) since water fluoridation began there. Results - there was a marked reduction in the DMF indices (teeth and surfaces) and in the dmf indices

HOLLIS, M.J. and Knowsley, P.C. Ten years of fluoridation in Lower Hutt. New Zealand D.J. 66:235-238 July 1970.

"Three year study to determine the caries-inhibiting effect of both a four minute and a 30 second topical application of SnF<sub>2</sub> applied annually to teeth of children (1250, age seven to nine) born and reared in a fluoridated community. Findings after two years essentially duplicate one year results and indicate there is a minimal beneficial effect in annual use of four minute topical application of eight percent SnF<sub>2</sub> on children but that a 30 second ten percent SnF<sub>2</sub> solution applied annually produces no reduction in incremental dental caries."

HOROWITZ, Herschel S. and Heifetz, Stanley B. I.A.D.R. Abstracts 1967 Evaluation of topically applied stannous fluoride to teeth of children born and reared in a fluoridated community. I.A.D.R. 1967.

Participants beginning study - 1,105 children, age five and six, in rural Oahu, Hawaii. After two years, 772 of original group available for re-examination. "Findings after two years show that the test agents, an acidulated phosphate-fluoride solution and gel, seem to be less effective in inhibiting dental caries on occlusal and buccolingual surfaces than on mesiodistal surfaces. These findings confirm those found after one year."

HOROWITZ, Herschel S. Effect on dental caries of topically applied acidulated phosphate-fluoride: results after two years. J.A.D.A. 78:568-572 Mar. 1969.

"After the first year of investigation, children in Group B experienced statistically non-significant decreases on teeth present on the baseline examination of 17 percent in incremental DMF teeth and 10 percent in incremental DMF surfaces compared with Group A. After two years benefits improved slightly and at the end of the study, 21 percent in caries increment were found on both DMF teeth and DMF surfaces in Group B. Children in Group C did not experience any decay preventive benefits during the study on teeth present when the study began that could not easily have occurred by chance. For children in both Groups B and C, the effectiveness of the stannous fluoride treatments was pronounced and statistically significant on teeth that erupted after the investigation was initiated."

HOROWITZ, Herschel S. and Heifetz, Stanley B. Evaluation of topical applications of stannous fluoride to teeth of children born and reared in a fluoridated community: final report. J. Dent.Child. 36:355-361, Sept.-Oct. 1969.

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"The professional application of a two percent solution of sodium fluoride can be recommended as an effective cariostatic procedure; reductions of 30 percent to 40 percent in the incidence of dental caries have been reported fairly consistently.....Because stannous fluoride produces pigmentation of teeth, additional studies should be made - also the reported masking of carious lesions on radiographs as a result of stannous fluoride should be investigated further.....At this time, there is insufficient evidence to recommend any self-administration procedure for topical fluoride application - be it toothbrushing, mouthrinses, or mouthpieces - for general use in public health programs."

HOROWITZ, Herschel S. and Heifetz, Stanley B. The current status of topical fluorides in preventive dentistry. J.A.D.A. 81:166-177 July 1970.

"This report presents final results obtained after the third annual follow-up survey in a study designed to test the caries-inhibiting effect of a topically applied acidulated phosphate-fluoride solution and gel. The follow-up survey included 681 of the original 1,105 Hawaiian children, ages ten to twelve. Findings from the first examinations were used for base-line data and for classifying the subjects according to sex, dental age and previous caries experience. Statistical analysis of the data is included to support the finding that acidulated phosphate-fluoride solution and gel are effective cariostatic agents."

HOROWITZ, Herschel S. The effect on dental caries of topically applied acidulated phosphate-fluoride: results after three years. J.A.D.A. 82:359-365 Feb. 1971.

"A twenty month study conducted in a non-fluoridated community to determine the caries-inhibitory effect of rinsing weekly during the school year for one minute with ten ml of a 0.2 percent neutral sodium fluoride solution. Subjects - 493 white and Negro children in Grade one and 381 in Grade five. Each group divided into comparable test and control groups. Control group rinsed with placebo solution.....After 20 months, 133 children rinsing with fluoride in Group One developed 25 percent fewer new DMFT and 16 percent fewer new DMFS than controls; after twelve months, their reductions had been 34 and 30 percent respectively. In grade five, 98 children who used the fluoride mouthrinse had 52 percent fewer new DMFT and 44 percent fewer new DMFS than 110 controls after twenty months. After twelve months, the fifth grade group had had 34 percent fewer new DMFT and 28 percent fewer DMFS than controls. Only the differences in grade five after 20 months were statistically significant. ( $p < 0.05$ ). Occlusal and buccolingual surfaces received protection in Grade one, but there were no benefits to mesiodistal surfaces. In grade five all types of surfaces were protected."

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HOROWITZ, H.S.; Creighton, W.E. and McClendon, B.J. The effect on human dental caries of weekly oral rinsing with a sodium fluoride mouthwash: A final report. Archs. Oral Biol. 16:609-616 June 1971.

"The occurrence of dental pigmentation following the topical application of stannous fluoride and its association with oral hygiene were investigated in a group of children residing in a nonfluoridated area. Examinations of 444 children for pigmentation and for status or oral hygiene were conducted approximately ten months following the last of two annual dental treatments.....The controls, consisting of 108 of these children had received treatment in which a non-fluoride prophylaxis paste only was used, whereas the other children in the study had received topical applications of stannous fluoride. The data on pigmentation were tabulated only for teeth which had received both of the two annual treatments. Observations follow: 1) the controls exhibited pigmentation on 29 percent of treated teeth. 2) greater prevalences of dental pigmentation were observed in the test groups (pigmentation was found on 39 percent of teeth of children treated with a prophylaxis paste containing 8.9 percent of stannous fluoride, on 48 percent of teeth treated with a four minute application of 8.0 percent stannous fluoride and on 54 percent of teeth treated with both fluoride-containing preparations. 3) a significant association found between dental pigmentation and oral hygiene (it increased as oral hygiene was neglected, and this relation maintained for the group of children who did not receive applications of stannous fluoride as well as for groups who did)."

HOROWITZ, Herschel S. and Chamberlin, Shirley R. Pigmentation of teeth following topical applications of stannous fluoride in a nonfluoridated area. J. Public Health Dent. 31:32-37 Winter Issue, 1971.

"Study conducted in a rural, nonfluoridated town in Tennessee from April 1965 to May, 1967. Approximately 300 children in first, second and third grades were randomly assigned to four groups as follows: I) Controls - received prophylaxis only. II) Treatment - received prophylaxis and topical application of acidulated fluoride solution by means of cotton applicator. III) Treatment - received prophylaxis and topical application of acidulated phosphate-fluoride solution by means of a reusable, hard rubber tray containing an absorbent paper liner. IV) Treatment - randomly subdivided in two groups. A - received prophylaxis and topical application of acidulated phosphate-fluoride gel by means of a moldable, wax tray. B - received a prophylaxis and a topical application of acidulated phosphate-fluoride gel by means of a disposable foam rubber tray. All children receiving the gel regardless of the type of tray used experienced 52.3 percent fewer DMFT increments and 41.2 percent fewer DMFS increments than the children serving as controls. The comparable figures for

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the solution-tray group were 23.9 percent and 13.1 percent respectively. ....The investigators recommend the use of the gel-foam rubber technique in public health programs of caries prevention. On individual patients in private offices, the gel-wax tray method may be used with equivalent effectiveness."

INGRAHAM, Robert Q. and Williams, J. Earl. An evaluation of the utility of application and cariostatic effectiveness of phosphate-fluorides in solution and gel states. J. Tenn. S.Dent. Assn. 50:5-12 Jan. 1970.

"Fluoride is unevenly distributed in enamel, the concentration on the outer surface and in early carious spots being much higher than that of the enamel generally. Only the outer surface is markedly influenced by age or the fluoride intake. The low concentrations of fluoride present in water lead to fluor-apatite formation; the high concentrations used in topical application and dentifrices lead, in addition, to calcium fluoride deposition. Evidence of the effect of fluoride in lowering enamel solubility is limited but generally supports it. Fluoride could affect solubility, 1) by increasing the proportion of fluor-apatite in enamel, 2) by favouring apatite formation rather than more soluble forms of calcium phosphate during 'recalcification' in early caries, 3) by increasing the size of the apatite crystals, 4) by replacing carbonate from enamel. The relative importance of these possibilities is unknown. Plaque contains high concentrations of fluoride but the available evidence suggests that it is not in a form which can inhibit enzymes except within a few days after topical application. Animal experiments suggest that fluoride ingestion reduces the size of teeth but data on human teeth are contradictory. The shape of fissures is also influenced by fluoride both in man and animals, but it is doubtful whether the differences are big enough to influence caries."

JENKINS, G.N. The mechanism of action of fluoride in reducing caries incidence. Int. D.J. 17:552-563, 1967.

"The jet-injection of toluidine blue dye was studied in chalk, soap, gelatin, gelatin embedded teeth, and adolescent and mature teeth and jaws of human cadavers. These in vitro studies showed that desirable dispersion and distribution patterns of jet-injected solutions can be obtained. The use of this approach has been suggested for 1) preventive dentistry by application of fluorides to unerupted teeth and bone; 2) oral medicine by administration of pharmaceutical agents for the control of diseases of soft and hard tissues, and 3) dental research by investigation of dental follicular circulation, and synovial and vascular pathways."

JOHNSON, Arthur R. and Sognnaes, Reidar F. Jet-injection technique applied to preventive dentistry. J.D.Res. 50:96-100 Jan.-Feb. 1971.

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"In March, 1969, 2,141 school children, ages six to twelve, were examined by the Albert Lea dentists to evaluate their fluoridation program. Albert Lea started fluoridation of public water supply in October, 1955. The children showing continuous residence on Albert Lea city water reveal the greatest reduction - approximately 50 percent. The children living on private well water but attending Albert Lea schools do receive some benefits from the city fluoridated water as do the children moving into the community at various ages. The fluoridation program has reduced the lost permanent tooth mortality by 67 percent. The survey reveals an increase in filled teeth among the school children with less than one tooth (.73) per child waiting to be filled. The dental health habits of the Albert Lea school children are good."

JORDAN, Wm. A. Fluoridated water benefits continue: Albert Lea's 1969 Dental Survey. Northwest Dentistry 49:77-80 Jan.-Feb. 1970.

"Eighteen years of fluoridation in Red Lake Falls continue to show impressive results with over 60 percent reduction in caries and a 94 percent reduction in the permanent teeth mortality. The rate of filled teeth has been increased by 22 percent."

JORDAN, William A. Eighteen years of fluoridated water as a caries inhibitor: Red Lake Falls. North-west Dent. 49:231-234 July-Aug. 1970.

"All residents of Monroe County given opportunity to participate in 'brush-in' with the new Indiana University Foundation self-applied zirconium silicate-stannous fluoride prophylactic paste. Article describes the planning and organization of project and necessity of community cooperation. Project began October 28 and ended November 8, 1968. Total of 33,254 treatments given. The 13,312 treatments given to children represents a total of 26,624 tooth surfaces which should not decay during next year. If one assumes the average cost of an amalgam restoration is \$5.00, then the prevention indicates a monetary savings of over \$133,000. A significant amount when compared to estimated cost of 'brush-in' of \$3,000.00."

KELLEY, Gordon E. The Bloomington "Brush-In" A new experience in dental caries prevention for mass treatment. J. Ind. D. Assn. 48:72-75 Feb. 1969.

"The evidence indicates that a fluoride build-up is in progress in the North American food chain which is exposing a considerable number of citizens to an intake above safe levels. There is a genuine need for more data to help determine the magnitude and extent of the upward shift in total fluoride intake....."

KINTNER, Robert Roy Dietary fluoride intake in the USA Fluoride 4:44-48 Apr. 1971.

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".....during the 25 years that water fluoridation has been operative, none of the claims of ill effects made by the antifluoridationists have been substantiated.....The claim that fluorides caused satyriasis and nymphomania never was subject to testing. Doing so might have proved to be an interesting and exciting investigation. I have speculated that if the voters in Seattle in their 1952 referendum knew what these two words meant, they might have voted to have a little of that stuff put into their drinking water supply."

KNUTSON, John W. Water fluoridation after 25 years. Brit. D.J. 129: 297-301 Sept. 15, 1970.

".....data indicate that the use of a self-applied stannous fluoride prophylactic paste in children residing in an area already enjoying the benefits of communal fluoridation is of significantly added value in reducing the incidence of dental caries. At all three examinations each of the examiners observed significant reductions in dental caries associated with the use of this treatment.....The home use of the stannous fluoride dentifrice in addition to the self-application treatments was not observed to be of significant additional value in the prevention of dental caries in this study. While in many instances numerically greater dental caries reductions were observed in the subjects receiving both types of stannous fluoride therapy, none of the observed differences at any of the examination periods were statistically significant when compared to the degree of protection in the subjects provided only the self-application treatment....."

LANG, Lawrence A.; Thomas, Harvey G.; Taylor, James A. and Rothhaar, Raymond E. Clinical efficacy of a self-applied stannous fluoride prophylactic paste. J. Dent. Child. 37:211-216 May-June 1970.

"Three examiners made parallel, independent clinical evaluations of the anti-carries effect of a stannous fluoride dentifrice containing stannous pyrophosphate and calcium pyrophosphate. The study was conducted over a period covering two school years using 190 secondary school students ranging in age from eleven to 18 years. The same subjects were examined independently by all three examiners. At the end of two years the reductions in caries increment for the group using the stannous fluoride dentifrice as compared to the group using the control dentifrice, were 33.9 percent for examiner A, 36.1 percent for examiner B, and 14.5 percent for examiner C."

LEHNHOFF, R.W.; Radike, A.W.; Muhler, J.C.; Peterson J.K. and Weisenstein, P.R. Clinical measurement of the effect of an anticaries dentifrice by three examiners. I.A.D.R. Abstracts, 1966.

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"After 25 years it has been proven that water fluoridation is a safe, effective and convenient caries preventive.....When controlled fluoridated water is ingested from birth, there is a reduction in the decay rate as much as 70 percent."

LESKE, Gary S. and Block, Marvin J. The current status of fluoridation in New York State. N.Y.S.D.J. 36:613-617 Dec. 1970.

Norrboten is the most northern county in Sweden - no water fluoridation. Public Health Service there provides all school children six to sixteen years with once a week rinse with two percent sodium fluoride solution (5 minutes of class time) and every two weeks or once a month for older children. There is a stain and brush demonstration (ten to 12 minutes class time). Results: 50 to 60 percent caries reduction and 80 percent reduction in gingivitis.

LINDGREN, Nils. Dental health education in Norrbotten. Dental Health 9:43-44 Sept. 1970.

".....silver and zinc salts are ineffectual in reducing caries..... Some 25 studies attest to the ability of four applications of two percent sodium fluoride to reduce the incidence of new caries about 30 to 40 percent in children and adolescents. Children drinking fluoridated water do not usually derive any additional benefits. The studies with adults have produced uniformly negative results. Four applications of two percent or four percent stannous fluoride produce a somewhat higher degree of caries reduction than the two percent sodium fluoride. One application of eight percent or ten percent stannous fluoride exhibits the same range of effectiveness as the multiple application of two percent sodium fluoride. A thirty second application of ten percent stannous fluoride seems to be as effective as the four minute application of eight percent. Stannous fluoride is of questionable effectiveness in adults. To date, use of a stannous fluoride prophylaxis paste in conjunction with the topical application of the eight percent solution does not appear to yield significant additive benefits. Sodium fluoride in phosphoric acid appears most promising as a topical agent."

MANDEL, Irwin D. and Cagan, Richard Pharmaceutical agents for preventing caries - a review II-topical application procedures. J. Oral Therapeutics and Pharmacology 2:128-144 Sept. 1965.

"A brief history of fluoridation has been summarized. Over a period of many years, findings of hundreds of studies have shown the fluoride adjustment of public water supplies to be a safe, effective, and economic procedure. An individual who receives the benefits of fluoridated water,



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at an optimum level, throughout his life, can look forward to a 50 to 70 percent reduction in dental decay, with no visible dental fluorosis, reduced dental bills, and much greater chance to retain his own teeth throughout his lifetime."

MANKIN, James D. Fluoridation - the greatest dental health advancement of the century. J. Kansas St. Dental Assn. 54:11-16 Jan. 1970.

"After a preliminary investigation to ascertain the duration of adhesion of some powders or pastes to the teeth and having examined the compatibility of NaF with them, the authors have tested the efficacy of such pastes in preventing dental caries by experiments carried out on laboratory animals and by means of 'enamel biopsy' on some groups of children. The positive results of the experimental and clinical investigations indicate the value of this new method of fluoroprophylaxis against dental caries."

MARCI, F.; Negri, P.L. and Staffolani, N. Experimental and clinical tests with a new method of fluorine prophylaxis of dental caries. Caries Res. 3:281-289, 1969.

"Saliva was sampled in children during and after supervised toothbrushing with a one percent sodium fluoride solution. Samples collected during toothbrushing showed fluoride concentrations in the range of 57 to 784 with an average of 378 ppm. During the first five minutes after brushing an average of 75 ppm fluoride was found. In a subsequent period of five minutes, the concentration had dropped to 28 ppm. Large individual variations were found."

MARTHALER, Thomas M. and Schait, Angela. Fluoride concentrations in saliva during and after supervised toothbrushing with one percent sodium fluoride solution. Helv. Odont. Acta 12:33-38 Apr. 1968.

"Blind examinations for caries in school children were carried out covering four communities, two of which had followed a scheme of fluoride tablet distribution in school for eight years or longer. Control and fluoride children were brought to common examination places and were thoroughly mixed prior to the blind examinations in order to exclude bias. Fluoride tablets (0.5-1.0 mg.F) distributed in school approximately 200 times a year were highly effective in inhibiting the development of dental decay. Mean percentage reductions were 36 percent for teeth and 47 percent for sites. Marked caries inhibition was found in free smooth surfaces of molars. A protective effect due to pre-eruptive fluoridation was not evident in a detailed comparison of first and second molars, the latter not being subject to post-eruptive fluoridation with sufficient regularity. The inhibition being due primarily to

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local fluoride accumulation in enamel surface layers and dental plaque, it is recommended that fluoride tablets should be kept in the mouth as long as possible."

MARTHALER, T.M. Caries-inhibiting effect of fluoride tablets. Helv. Odont. Acta. 13:1-13 Apr. 1969.

"The caries-inhibiting effect of ten topical applications by means of tablets containing ten mg. of fluoride was tested on 442 children over a period of two years. The inhibitory effect appeared significant and was in the order of magnitude of 23 to 35 percent."

MARTHALER, T.M. and Muhlemann, H.R. Clinical anti-caries effect of supervised toothbrushing with fluoride tablets for topical application. Helv. Odont. Acta. 14:77-79, Apr. 1970.

"Supervised toothbrushing with a one percent fluoride gel during six minutes performed 30 times during the first year of observation and performed 16 times during the second and third year each resulted in a statistically significant ( $P < 0.0001$ ) inhibition in DFS increments. A supplementary study failed to detect a statistically significant effect of 16 brushings per year with the same preparation, but due to the small number of children the power of this part of the investigation was very limited. The caries-protective effect of a clinically tested fluoride dentifrice was detected with statistical significance only in the supplementary study."

MARTHALER, T.M.; Konig, K.G. and Muhlemann, H.R. The effect of a fluoride gel used for supervised toothbrushing 15 or 30 times per year. Helv. Odont. Acta. 14:67-77 Apr. 1970.

"A fluoride analysis was conducted on the outer four layers of enamel from 318 deciduous and 89 permanent teeth (premolars) collected over a period of thirty months from schoolchildren, who had consumed fluoridated water from birth and received varying numbers of treatments with gel drops containing 1.1 percent sodium fluoride. It was found that treated deciduous and permanent teeth acquired significantly more fluoride in comparable enamel layers than did the untreated teeth of children who consumed only fluoridated water. The fluoride acquired from the topical treatment appeared to be permanently bound to the enamel and became progressively greater as the number of treatments completed before a tooth was exfoliated or extracted increased. The enamel of the permanent teeth appeared to acquire slightly less fluoride from the topical treatments than the deciduous teeth, but finished with a higher fluoride concentration than the deciduous teeth because of higher initial fluoride levels."

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MELLBERG, James R.; Nicholson, Clyde R.; Miller, Barry G. and Englander, Harold R. Acquisition of fluoride in vivo by enamel from repeated topical sodium fluoride applications in a fluoridated area: final report. J.D.Res. 49:1473-1477 Nov.-Dec. 1970.

"Five hundred twenty-three children, eleven to twelve years old, participated. The purpose was to evaluate the possible caries inhibiting effect of sodium hexafluorostannate (0.57%) when used for topical application. Topical applications with a two percent aqueous solution of sodium fluoride were undertaken in order to serve as an intermediate control. The children were assigned to one of the following groups: A) (H<sub>2</sub>O), B) (NaF) and C) (SnF<sub>6</sub>..) Each child received four applications (two applications with an interval of one week at the start of the study and after one year.) The study performed on a double blind basis throughout. As compared to group A), the reduction in dental caries increment (DMFs/child) obtained after two years, was approximately 30 percent for group B) and approximately 40 percent for group C). The difference between group A) and B) and between group A) and C) was highly significant whereas the difference between group B) and group C) was not quite on the five percent level of significance."

MØLLER, I.J.; Schaltz, G. and Altermann, S. A clinical trial on the caries-inhibiting effect of sodium hexafluorostannate. Caries Res. 3:315-325, 1969.

"After eleven years of controlled fluoridation, the caries prevalence of Fayette, Alabama children was compared with a five year post-fluoridation study and pre-fluoridation data. In the seven year group, there was approximately the same reduction in DMF rate after five years. (48.9%) and eleven years (51.1%). Beginning with the eight year olds, there was a much greater reduction in decay rate for all ages after eleven years of fluoridation. Controlled fluoridation of a community water supply in Alabama is very effective in reducing tooth decay, but to obtain maximum benefits, children must received fluoridated water during the tooth formative years....."

MONCRIEF, Everette W., Jr. Results of eleven years of fluoridation in Fayette, Alabama. J. Ala. D. Assn. 54:18-25 Jan. 1970.

Clinical data obtained in a series of six independent clinical studies is summarized (with tables) and results suggest technique is effective in reducing the incidence of dental caries.

MUHLER, Joseph. Mass treatment of children with stannous fluoride-zirconium silicate self-administered prophylactic paste for partial control of dental caries. J. Am. Coll. of Dentists 35:45-57 Jan. 1968.

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"An improved prophylactic paste containing  $ZrSiO_4$  and  $SnO_2$  has been developed and evaluated. The data suggest that this abrasive system increases enamel polish with no increase in enamel or dentin abrasion and cleans enamel as well as  $ZrSiO_4$  abrasive. The incorporation of  $SnF_2$  into a prophylactic paste utilizing this cleaning and polishing system results in highly significant reductions of enamel solubility in vivo ranging from 77.3 to 82.0 percent."

MUHLER, Joseph C. and Stookey, George K. The development of an improved  $ZrSiO_4$  prophylactic paste. J. Periodont. 41:290-293 May 1970.

"Stannous fluoride-calcium pyrophosphate dentifrice has been shown to be clinically effective under widely varying conditions. The author laments the apathy of the public toward easily available methods of caries prevention. (The fact that about 45 percent of the toothpaste currently consumed in the United States each year does not contain fluoride indicates widespread misunderstanding about the value of fluoride dentifrices, confusion about which products contain fluoride, apathy about dental health, or perhaps all three.) The purpose of the study reported here was to compare two commercial products which essentially represent two different mechanisms for inhibiting the dental caries process. This study compares the anticaries effectiveness of a  $SnF_2$  -  $Ca_2P_2O_7$  dentifrice with a sarcosinate dentifrice.....Results after six months and one year showed the stannous fluoride dentifrice to be significantly superior to the sarcosinate dentifrice. Comparison of each test product with a placebo showed a significant dental caries reduction from the stannous fluoride dentifrice and no caries reduction for sarcosinate dentifrice."

MUHLER, Joseph C. A clinical comparison of fluoride and antienzyme dentifrices. J. Dent. Child. 37:501-502, 511-514 Nov.-Dec. 1970.

"During the period between 1964 and 1967 a total of 1,808 male students of 13 and 14 years of age were examined at the N.C. Advancement School. The caries experience and oral hygiene of each student was recorded and the data analyzed by the students age, race and residence in North Carolina and length of exposure to fluoridated water. The differences in caries-experience and oral hygiene in relation to these variables was determined. The black students demonstrated less caries-experience, but a greater amount of oral debris and calculus, than the whites. The black students, as a group, exhibited fewer decayed teeth that had been filled. For both black and white, the caries-experience was greater among the students from the Piedmont region than from the Coast, and greater again among the students from the Mountain region than among those from the Piedmont. Those students who had been constantly exposed to fluoridated water during the first eight years of their lives had less caries-experience and better oral hygiene than did those students who reported no

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exposure to fluoridated water."

MURPHY, Richard F.; Hughes, John T. and Dudney, George G. Dental health status of students at the North Carolina advancement school. J. Public Health Dent. 30:234-238 Fall Issue 1970.

"Caries experience of 386 - 15 year old children from the fluoride community of West Hartlepool (1.5 to 2.0 ppm F) was 45 percent lower than that observed in 381 - 15 year old children from the low fluoride area of York (0.2 ppm F). The inhibitory property of fluoride drinking water is not uniform from tooth to tooth nor from site to site on the same tooth. The greatest degree of inhibition was observed on the approximal surfaces of maxillary incisors, where caries attack was inhibited by approximately 90 percent. Caries attack on smooth surfaces of first permanent molars was inhibited by 66 percent. In the anatomical lingual pit of maxillary incisors caries inhibition was 62 percent, whereas the inhibition of caries in pits and fissures of first permanent molars was 38.5 percent. It is not possible to assess how preventive fillings in these sites have masked the true picture."

MURRAY, J. Caries experience of 15 year old children from fluoride and non-fluoride communities. Brit. D.J. 127:128 Aug 5, 1969.

"Evidence from this investigation indicated that fluoride in drinking water, at least up to the level of two ppm, has no influence of any notable value on the prevalence of gingivitis, on its extent or on the relative distribution of gingivitis in individual labial papillae and margins associated with anterior teeth in 15 year old children. An interesting feature of this investigation was that the apparent sex difference in the prevalence and extent of gingivitis disappears when only those with good oral cleanliness are considered. This observation has been made previously by James (1962) in study of eleven to 13 year old children. The inference is that observed apparent sex differences in the total prevalence of gingivitis are due to sex differences in the standards of oral cleanliness. In those children with good oral cleanliness, the prevalence and the extent of gingivitis was less than in the communities as a whole, but even in this group there was still a substantial level of gingivitis. This was also noted by Sutcliffe (1968)."

MURRAY, J.J. Gingivitis in 15 year old children from high-fluoride and low-fluoride areas. Archs. Oral Biol. 14:951-959 Aug. 1969.

"A double-blind controlled clinical trial of three years duration has been completed to test the effectiveness of the unsupervised use by eleven to twelve year old children of toothpastes containing stannous fluoride and sodium monofluorophosphate. Results show both pastes produced significant

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reductions in caries experience as compared with control paste, the reductions greatest in respect of new carious surfaces in teeth which erupted during the study. Greater reductions were demonstrated in the monofluorophosphate group than the stannous fluoride group, but the differences between the two were not significant. An assessment of the degree of staining present on anterior teeth at the fourth examination, showed that the stannous fluoride formulation was specifically responsible for a brown-black staining of the teeth. The staining present in the monofluorophosphate groups was similar to the control group, thus indicating no specific staining action of monofluorophosphate paste."

NAYLOR, M.N. and Emslie, R.D. Clinical testing of stannous fluoride and sodium monofluorophosphate dentifrices in London school children. Brit. D.J. 123:17 July 4, 1967.

"1) The combined age groups showed a reduction of 25 percent in DMF six year molars due to five years of fluoridation at one part per million concentration. 2) The seven year old group who started on fluoridation at two years of age, showed by far the greatest improvement - 64.3 percent reduction in DMF teeth. 3) United States studies on similar areas and time periods have shown greater average reductions for similar age-groups than has the Naas-Athy study. Should further evidence on these lines become available, it should give rise to a re-consideration of an Irish optimal."

O'CARROLL, F.M.; Flanagan, B. and Kehoe, J. NAAS-ATHY Six-year molar fluoridation study 1969 - Dental Investigation. J. Irish Dent. Assn. 16:1-6 Jan.-Feb. 1970.

"Two hundred five children, six to eight years old, given sprays annually with a weak acidulated phosphate-fluoride solution without prior prophylaxes. Twelve month examination included an assessment of oral hygiene according to the method of Greene and Vermillion. At the end of three years a significant reduction of 13 to 18 percent in new DMF surfaces was found as compared to the 204 controls. Within the control group subjects with better hygiene had statistically significant advantage with respect to caries increments over those with poor hygiene. Within the treated group the differences in caries increments between individuals with favorable and unfavorable hygiene did not quite reach statistical significance, possibly because the disadvantage of poor hygiene was partially overcome by the fluoride effect. In addition individuals with high initial DMF counts tended to have poorer hygiene during the course of the study while those with low initial counts tended to have better hygiene. It was concluded that the treatment method with its limited cariostatic effect might be useful in low-cost public health programs or in lieu of tap-water rinsing during routine operative procedures. Furthermore, oral hygiene and fluoride exposure appear to be important interacting determinants of caries activities."

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de PAOLA, P.F.; Wellock, W.D.; Maitland A. and Brudevold, F. The relationship of cario-stasis, oral hygiene, and past caries experience in children receiving three sprays annually with acidulated phosphate-fluoride: three year results. I.A.D.R. Abstracts 1968.

"The fluoride concentration in saliva after chewing the fluoride tablet is well below that of the agents routinely used for topical fluoride application. Consequently, the daily chewing of fluoride tablets should not be used as a substitute for biannual topical fluoride treatments. Chewing fluoride tablets are probably of value as a means of maintaining the fluoride concentration in the surface enamel."

PARKINS, Frederick M. Fluoride concentration in saliva after chewing fluoride tablets. J.D. Res. 50:515 Mar. 1971.

"Approximately 1,050 white children, nine to 15 years of age, divided in three groups according to age, sex and family. All received annually a thorough dental caries examination, including radiographs by single examiner. Group I) received test dentifrice (ph 4.8-5.3) containing 0.22 percent sodium fluoride, 1.5 percent soluble orthophosphate and an insoluble sodium metaphosphate abrasive (Ipana). Group II) - commercially available dentifrice (ph 4.6-5.0) containing stannous fluoride and calcium pyrophosphate (Crest). Group III) - commercially available fluoride-free dentifrice (ph 7.5-7.6) (Gleem). All children were supplied with fresh dentifrice and brushes at regular intervals for unsupervised home use. DMFT increments in three years were 18 and 22 percent less in Groups I) and II) than in Group III). Occlusal, buccal-lingual, proximal and total DMFS increments were respectively 16,14,22 and 20 percent less in Group I) and 17,19,29,25 percent less in Group II) than in Group III)."

PETERSON, John K. and Williamson, Lois. Three year caries inhibition of a sodium fluoride acid orthophosphate dentifrice compared with a stannous fluoride dentifrice and a non-fluoride dentifrice. I.A.D.R. Abstracts 1968.

"A two year study was conducted to determine the caries inhibitory effectiveness of a freshly prepared acidulated phosphate fluoride-pumice prophylactic paste applied once a year to children aged ten to 13 in a fluoridated community and a nonfluoridated community. (1100 children began study). Two examiners found consistently smaller DMFT, DMFS, and proximal surface increments in the treated groups with visual-tactile examinations. However, the only differences significant at the 0.05 level were those found in the nonfluoridated community with combined visual-radiographic examinations."

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PETERSON, John K.; Horowitz, Herschel S.; Jordan, William A. and Pugnier, Vincent. Effectiveness of an acidulated phosphate fluoride-pumice prophylactic paste: a two-year report. J.D.Res. 48:346-350 May-June 1969.

"Approximately 5,000 randomly selected children were examined. Approximately 50 percent had received some form of fluoride supplements. 1) A statistically significant difference was observed between the number of children caries-free, who had received fluoride supplement before, and after birth and the number who had not. 2) A marked difference was seen in the def rates of those children who had received fluoride supplements and those who had not. The findings demonstrate the benefits of pre- and post-natal fluoride supplements."

PRICHARD, J.L. The pre-natal and post-natal effects of fluoride supplements on West Australian school-children, aged 6, 7, and 8, Perth, 1967. Aust. D. J. 14:335 Oct. 1969.

"This report deals with a new study to test the cariostasis obtained from a SnF<sub>2</sub> self-polishing (self preparation) technique, as compared with an operator applied SnF<sub>2</sub> prophylaxis technique as part of the 'three agent' treatment method in preventive dentistry. Subjects are United States Navy enlisted men, 18 to 22 years of age, with no previous topical SnF<sub>2</sub> exposure. After six and twelve months statistical analysis reveals a significant reduction in the DMFS increment of the experimental over the control groups and that the self-prepared technique appears to be as effective as the operator applied technique."

SCOLA, F.P. Self-preparation SnF<sub>2</sub> prophylactic technique in preventive dentistry - progress report. I.A.D.R. Abstracts 1967.

"A study was done on 18 to 22 year old enlisted men in United States Navy to test the cariostatic potential of a self-preparation stannous fluoride prophylaxis technique. Significant reductions in the DMFS and DMFT increments of the experimental groups as compared to control groups. The interproximal flossing of the aqueous SnF<sub>2</sub> topical application can be eliminated with no significant decrease in effectiveness of the technique. The self-prepared prophylaxis technique is as effective as the operator-applied prophylaxis technique in the three agent SnF<sub>2</sub> treatment. A substantial saving in time could be realized by the substitution of the self-prepared prophylaxis phase for the operator-applied prophylaxis phase of the three agent SnF<sub>2</sub> treatment method in the Navy's preventive dentistry program."

SCOLA, Francis P. Self-preparation stannous fluoride prophylactic technique in preventive dentistry: report after two years. J.A.D.A. 81:1369-1372 Dec. 1970.



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"At present, there are substantial reports that topical application of two percent sodium fluoride and more recently developed technique of eight percent Stannous fluoride application is significant stride to counteract the caries problem on a public health basis. Although children are the main to benefit from eight percent of stannous fluoride applications, Muhler, the architect of this measure claims that ten percent of the solution could also be beneficial to adult population."

SHANKWALKAR, G.B. Role of public health dentistry as a preventive measure. J. Indian Dent. Assn. 42:127-130 May 1970.

"Aqueous solutions of stannous fluoride were evaluated as agents for reducing lactic acid decalcification of human dental enamel. Performance was measured by the amount of phosphorus removed from enamel before and after fluoride treatment. Phosphorus was determined automatically on the Auto-Analyzer. SnF<sub>2</sub> solutions of 5.0, 10.0 and 20.0 percent concentration were significantly more effective than 0.4, 0.7 and 1.0 percent solutions. Aqueous preparations of stannous fluoride maintained their protective potency throughout the 12-week experimental period."

SHANNON, I.L.; Hester, W.R.; Belli, E.F. and Blankenship, J.R. Effect of aqueous stannous fluoride on enamel solubility. SAM-TDR-62-63 May 1962.

"The in vitro effectiveness of an aqueous stannous fluoride (approximately 20 percent) prophylaxis paste was determined by measuring the amount of phosphorus removed from enamel surfaces both before and after treatment with the paste. Treatment reduced enamel solubility by over 90 percent in all experimental groups, and there was no loss of effectiveness when the paste was aged over an eight-week period. The substitution of liquid petrolatum, or silicone and petrolatum in combination, for water, did not increase effectiveness."

SHANNON, I.L. and Hester, W.R. The effect of an aqueous stannous fluoride prophylaxis paste on enamel solubility. SAM-TDR-62-79 June 1962.

"Solutions containing one percent, 0.4 percent and 0.1 percent stannous fluoride were prepared with water and with glycerin as solvents. Concentrations of stannous tin, total tin and fluoride were measured at monthly intervals over a 15 month aging period. The aqueous solutions lost from two-thirds to three-fourths of the original stannous tin content during aging. An average of approximately half of the total tin and about one-fifth to one-fourth of the fluoride was lost from those water-based preparations. When stannous fluoride was dissolved in glycerin the above described chemical changes were completely prevented. A flavored gel containing 0.4 percent stannous fluoride in water-free solution was

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evaluated for its ability to reduce enamel solubility over a 16 week aging period. The gel was diluted with an equal weight of water immediately before a two minute topical application. Enamel solubility reduction ranged from 45.7 percent to 54.7 percent and there was no decrease in effectiveness associated with aging. The results of the present study, along with those based upon a prophylaxis paste prepared with the same liquid phase, suggest a method for the preservation of chemical integrity in stannous fluoride solutions."

SHANNON Ira L. Water-free solutions of stannous fluoride and their incorporation into a gel for topical application. Caries Res. 3:339-347 1969.

"An evaluation was made of the enamel solubility reducing characteristics of aqueous solutions of  $\text{SnF}_2$ , NaF, APF, and MFP. These preparations were tested on the crowns of extracted human teeth and were applied both alone and in combination with other solutions. When  $\text{SnF}_2$  was the initial treatment compound, the application of any one of the other three solutions reduced the protection afforded by  $\text{SnF}_2$ . When  $\text{SnF}_2$  treatment was preceded by application of any one of the other three preparations, the additive effect was highly significant. This was particularly true when APF treatment was followed by an application of  $\text{SnF}_2$ , a procedure which increased the enamel solubility reduction rate to 95.7 percent. This combination of treatments is recommended for clinical use as a technique which might provide for the enamel surface a more durable resistance to dissolution."

SHANNON, Ira L. Enamel solubility reduction by topical application of combinations of fluoride compounds. J. Oral Med. 25:12-17 Jan.-Mar. 1970.

"An evaluation was made of the following topical treatment procedures in the ability to reduce enamel solubility: APF, 0.5 percent  $\text{SnF}_2$ , 2.0 percent, NaF, six percent MFP, dual treatments with APF, dual treatments with 0.5 percent  $\text{SnF}_2$ , and APF followed by 0.5 percent  $\text{SnF}_2$ . A comparison was made of the amount of enamel solubility reduction provided by each treatment procedure under routine laboratory conditions and, in addition, the ability of the protection to resist displacement by exposure to ultrasound was studied. Treatment with APF followed by  $\text{SnF}_2$  provided an initial protection level of 95.5 percent. This treatment was significantly more effective than any other single or combined treatment. After exposure to ultrasound, this protective level was maintained at 86.6 percent, this figure far exceeding that provided by any other approach....."

SHANNON, Ira L. Dual application of fluorides. N. Mexico D.J. XXI:32-36 May 1970.

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"Findings of this laboratory study suggest that two minute sequential topical applications of acidulated phospho-fluoride and stannous fluoride decrease the surface solubility of dental enamel and afford more durable protection than obtained when either agent is used alone."

SHANNON, I.L. In vitro enamel solubility reduction through sequential application of acidulated phospho-fluoride and stannous fluoride. J. Canad. Dent. Assn. 36:308-310 Aug. 1970.

"Question: What is the effect of fluoride on dentin? - Answer: The use of stannous fluoride or fluoro-phosphate liquids will increase the resistance of the peritubular and intertubular dentin to acid decalcification. Apparently, fluoride aids the process of remineralization which results in less acid penetration into the deeper layers of dentin. There is no apparent pulpal reaction to fluoride solutions; however, the use of fluoride on near exposures is not recommended. Some commercial fluoride varnish cavity liners are available."

deSHAZER, D.O. Questions and answers on fluoride. Omaha Dist. D. Soc. 33:77 Nov. 1969.

"A double-blind clinical trial was conducted for a period of three years on children aged initially eleven and twelve to determine the effect on dental caries incidence of the use of a stannous fluoride calcium-free abrasive system dentifrice and a sodium fluoride/acid orthophosphate dentifrice when compared with a commercially available stannous fluoride/calcium pyrophosphate dentifrice, a commercially available non-fluoride dentifrice, and a control group receiving neither any particular dentifrice nor any oral health instruction. A significantly lower DMF(S) increment was demonstrated in those groups using the stannous fluoride and the commercial fluoride dentifrices when compared with the control group. The greatest reduction, 23.6 percent occurred with the stannous fluoride group. The trial indicates that both the stannous fluoride calcium-free abrasive system and the commercially available stannous fluoride dentifrice had a better cariostatic action than the non-fluoride dentifrice."

SLACK, G.L.; Bulman, J.S. and Osborn, J.F. Clinical testing of fluoride and non-fluoride containing dentifrices in Hounslow School Children. Brit. D.J. 130:154-158 Feb. 16, 1971.

"It has been reported that fluoride in human enamel that results from topical applications of fluoride solutions is present in concentrations that are highest at the surface and decrease with increasing depth below the surface. It has also been observed that the fluoride concentration found in the enamel immediately after a topical application falls rapidly. These observations suggest that in incorporation of fluoride by human

enamel under these conditions is a surface phenomenon and that the mechanism involves the process of diffusion wherein both interstitial and substitutional fluoride moieties are acting. This study tested this hypothesis from a phenomenological viewpoint and attempted to develop an atomistic or kinetic approach to the explanation of the mechanism of incorporation of fluoride by human enamel.....The relationship between the concentrations of fluoride in enamel at various depths and the concentrations of the hydrogen ion and the total fluoride ion in the topical agent is formulated mathematically. The same relations explain the loss of fluoride after a topical treatment and show that this loss is a thermodynamic necessity and therefore cannot be prevented, except perhaps by completely sealing the enamel off from the oral environment by some impermeable film. The diffusivity of enamel toward the diffusing fluoride moieties is not the same for all teeth - reasons for differences lie in histories of individual teeth....."

STEARNS, Robert I. Incorporation of fluoride by human enamel: I. Solid-state diffusion process. J.D.Res. 49:1444-1451 Nov.-Dec. 1970.

"In their defense of the 'proven harmlessness to human health of artificially fluoridated water' pro-fluoridationists often speak of 'the optimum level of fluoride in drinking water' and maintain that 'such an optimum level' constitutes no danger to human health. It is, however, inconceivable how one could speak of 'an optimum level of fluoride in drinking water' when 1) no two individuals drink the same quantity of water daily; (it is explained elsewhere in this address that one individual may drink up to 20 times or more water than another) 2) the fluoride content of fluoridated water drawn at different distances from the center of fluoridation may, and does, vary to a considerable extent." (Author recommends fluoride-containing toothpastes that constitute no danger to human health and well-balanced diets to control dental caries.)

STEYNE, D.G. Fluoridation of public water supplies. Pakistan Dental Review XX:5-27 Jan. 1970.

"A one percent stannous fluoride mouthwash was tested on 168 Negro children divided in two balanced groups. The control group rinsed daily with a placebo mouthwash and the test group rinsed daily with a one percent stannous fluoride mouthwash prepared fresh every day. The test period extended from January 1, 1966 to May 30, 1966. The program was administered in a public school under the supervision of classroom teachers. The group using the stannous fluoride mouthwash had 33 percent less carious teeth and 30.5 percent less carious surfaces. This reduction statistically was not significant. Both groups had a eleven percent decrease in their periodontal indices and a 25 percent decrease in their oral hygiene indices. A daily mouthwash can be administered in a public school setting, and supervised by non-dental professions (classroom teachers)."

SWERDLOFF, George and Shannon, Ira L. Feasibility of the use of stannous fluoride mouthwash in a school system. J. Dent. Child. 36:363-368 Sept.-Oct. 1969.

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"Solutions of sodium fluoride, stannous fluoride and acidulated phosphate-fluoride and a prophylactic paste of stannous fluoride were applied by Muhler's 30 second technic and Knutson's multiple-chair technic. (Knutson's technic: after applying solution to teeth, they are isolated by cotton rolls and allowed to dry in air for approximately three minutes). Conclusions: 1) after four years the two percent solution of sodium fluoride applied in a single series of four applications, and three single annual applications of eight percent solution of stannous fluoride applied by Knutson's technic showed statistically significant less new DMF teeth and DF surfaces than for the group of controls. 2) A single series of four applications of acidulated phosphate-fluoride solution produced a statistically significantly lower three year incidence of carious lesions than the controls but not as great as the solutions of sodium or stannous fluoride. 3) None of these agents produced significant results when applied by Muhler's 30 second technic. 4) A prophylactic paste containing stannous fluoride, when used without a subsequent topical application of fluoride solution, produced no significant cariostatic effect. 5) An index of cariostatic efficiency divided by the time for the technic indicated that the applications topically of sodium fluoride by Knutson's technic may provide the most efficacious agent when evaluated administratively." (2,700 participants, 1,776 available for fourth annual examination.)

SZWEJDA, Louis F. Fluorides in community programs: results after four years of study of various agents topically applied by two technics. J. Public Health Dentistry 31:166-176 Summer Issue 1971.

In a two year clinical study of dental caries conducted in six institutional homes for children ( eight to 16 years old), two experimental dentifrices were used. Slightly different combinations of sodium monofluorophosphate and sodium n-lauroyl sarcosinate effected a statistically lower incidence of dental caries than the control toothpaste. The rates of incidence of dental caries were comparable for the children who used the two experimental dentifrices."

THOMAS, Adeeb E. and Jamison, Homer C. Effect of a combination of two cariostatic agents in children: two-year clinical study of supervised brushing in children's homes. J.A.D.A. 81:118-124 July 1970.

"Local fluoride application methods with proven caries prevention effect are fluoride paintings, mouth-rinsing or toothbrushing with fluoride solutions and the use of fluoride dentifrices. At present sodium fluoride is the most firmly established compound for clinical routine use by means of painting, rinsing or brushing. The clinical trials performed to date are insufficient to demonstrate conclusively the relative prophylactic efficiency of the different dentifrices which are now on the market. The use of fluoride polishing preparations in the dental chair is a valuable complement to other methods for local fluoride application.

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The effect of local fluoride treatment is related to the frequency of application."

TORELL, P. and Ericsson, Y. The value in caries prevention of methods for applying fluorides topically to the teeth. Int. D.J. 17:564-581 1967.

"Fluoridation of drinking water in Singapore had lowered the prevalence rate of dental caries of the primary dentition by 30.8 percent in ten years of observation. There was no corresponding fall in the prevalence rate of dental caries among children of Malacca where the water was not fluoridated. For the permanent dentition, fluoridated water in Singapore reduced the prevalence of dental caries from 2.9 mean DMF teeth per child (1957) to 2.0 mean DMF teeth per child (1966) a reduction of 31 percent in Malay children seven to nine years old. The mean DMF teeth per child of Chinese children seven to nine years old was reduced from 4.4 to 2.1 representing a reduction of 52.2 percent. In the mixed dentition of Singapore children, the prevalence rate of dental caries also fell, whereas that of Malacca children remained relatively static. The DMF rate of permanent first molars of Singapore Malay children seven to nine years of age, fell by 0.9 mean DMF teeth per child; and by 1.3 mean DMF teeth per child of Singapore Chinese children seven to nine years of age. The percentage of teeth showing enamel opacity of idiopathic origin was higher in Singapore children than in Malacca children. From 1966 to 1968 enamel opacity due to fluorosed enamel accounted for approximately five percent of the total number of teeth affected of Singapore children."

WONG, M.G; Goh, S.W. and Oon, C.H. A ten-year study of fluoridation of water in Singapore. D.J. Malaysia and Singapore 10:20-40 Oct. 1970.

"Double-blind study of comparative efficacy of a neutral pH dentifrice containing sodium fluoride and calcium pyrophosphate conducted on 848 children, seven to 14 years of age, divided into three groups: I) stannous fluoride-stannous pyrophosphate-calcium pyrophosphate dentifrice; II) sodium fluoride-calcium pyrophosphate dentifrice; III) calcium pyrophosphate dentifrice without the active ingredient. Both dentifrices contained fluoride at the level of 1000 ppm. Examinations at commencement, twelve months, and 20 months. At twelve months the stannous fluoride dentifrice demonstrated a caries reduction of 38.9 percent and the sodium fluoride dentifrice a reduction of 31.3 (DMFS). At 20 months the reductions demonstrated were 27.6 percent and 28.4 percent respectively (DMFS). These reductions are significant."

ZACHERL, W.A. A clinical evaluation of sodium fluoride and stannous fluoride dentifrices. I.A.D.R. Abstracts, 1968.

"This is a final report on the anticariogenic efficacy of a stannous fluoride-calcium pyrophosphate - stannous pyrophosphate dentifrice and shows consistent reductions in new DMF surfaces and teeth after the, 18, and 30 months intervals. The reductions for surfaces range from 39 to 42 percent; those for teeth range from 34 to 44 percent. The results were proportional to the subjects' caries rates but unrelated to their age."

ZACHERL, W.A. and McPhail, C.W.B. Final report on the efficacy of a stannous fluoride-calcium pyrophosphate dentifrice. J. Canad. Dent. Assn. 36:262-272 July 1970.

"Through the data gained from the study, it seems obvious that the superiority shown by the participating school students in answering the questions over the non-participating school student illustrates the effectiveness of the dental health educational program provided by the dental hygienist."

ZODY, Sandra L. A study comparing a dental health education program among first, third and sixth grade children. J. Indiana D. Assn. 49: 93-98 Mar. 1970.

"In 1945, the first test of the dental benefits of adding fluoride to the drinking water was begun in Grand Rapids, Michigan. Three more tests were initiated soon thereafter in Newburgh, New York; Brantford, Ontario and Evanston, Illinois. The combined population of those four cities at the time was less than a million and about five million people in the United States were served by water supplies that naturally contained fluoride. By 1970, close to 90 million United States residents were drinking fluoridated water. The credit for the remarkable progress in instituting a general health measure that former Surgeon General Luther J. Terry once hailed as the most significant of our times goes to a relatively small group of scientists who dispassionately followed the path of reason against discouraging odds. Fluoridation lost in two-thirds of the first 900 referendums, reason eventually turned the tide and we can be happy about that but the successes so far have been for the most part hard won, community by community. Seven states have taken the enlightened and easier approach of making water fluoridation mandatory by state law. Connecticut first in 1965. Minnesota, Illinois, Delaware, Michigan, South Dakota and Ohio followed.....Although there are nearly 90 million people in our country who drink fluoridated water, there are 115 million who do not and more than half of those are served by water supplies that could be fluoridated. If all fifty states had fluoridation laws, 150 million could be served. The 43 states that do not have such laws should have."

AUTHOR UNKNOWN:(Editorial) Twenty-five years of fluoridation. J.A.D.A. 80:697 Apr. 1970.

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Article reviews: the occurrence and importance of fluorine, the supply of fluorine to man, absorption of fluorine, distribution of fluorine in the body, excretion of fluorides, physiology of small fluoride doses, toxic effects of large fluoride doses. Concludes with: "while fluoridation is beneficial to the teeth there is still a great deal to be learned about the basic physiology of fluoride in the human body and encourages research into the etiology of dental caries, fluoride content of diets, the mechanism of action of fluoride at optimal concentrations in drinking water and the effects of greatly excessive intake of fluoride from natural sources."

AUTHOR UNKNOWN: Fluorides and human health. Dental Health 9:53-61 July-Sept. 1970. (reprinted from WHO 24:no.6 1970.)



## VIII. ORAL IRRIGATION

FROM ARNIM'S OPINION: "'Bacterial plaque' and calculus are not the sole 'local factors' involved in effective oral hygiene procedures. Additional elements have been revealed (epithelial cells, white blood cells, red blood cells, serous exudates, motile bacteria, amoeba, trichomonads, non-motile cocci and rods, bizarre microbial forms and flocculent masses) capable of producing or forming noxious waste products. They are the predominant 'local factor' in those cases where the teeth have little or no bacterial plaque or calculus on their surfaces.....In other words, the patient must know that this factor is real, that it is present where toothbrush and floss CANNOT reach it and that it must be removed by gentle flushing of the subgingival spaces.....in order to obtain an effective oral hygiene procedure."

ARIAUDO, Arnold, Arnim, Sumter S., Greene, John C. and Loe, Harald..

IN OUR OPINION: How frequently must patients carry out effective oral hygiene procedures in order to maintain gingival health? J. Periodont. 42:309-313 May 1971.

"Continued microscopic studies of patients who use dental irrigators regularly convinced us that the microbial inhabitants thrive primarily on discharged 'serums'. Food debris plays an inconsequential role in maintenance of the community. The best unit for removing the subgingival residues was the one the patient could use most effectively for thorough removal of the microcosm with its gels, cells, and microbes which accumulate in the subgingival spaces."

ARNIM, Sumter S. Dental irrigation - its place in the total concept of oral hygiene. Dental Practice 3:7-10 Sept. 1965.

"The most important requirement is that the instrument be simple, practical and readily available at a reasonable price. They should not damage tissues and their correct use should be readily understood. Irrigators should not cause pain or bleeding. All investigators with long term clinical experience emphasize the benefits of large quantities of hot water for relatively long periods of time, ten to 20 minutes per application with one or more gallons per minute. The stream of water should be copious and gentle in order to produce effective flushing action. Faucet connected irrigators are necessary in order to supply large quantities of warm water with least trouble to the patient. Experience here indicates that the good effects may be obtained in less time per session; the job is done when further irrigation fails to remove additional microcosm. The irrigator tip should be designed so that it will direct the stream into subgingival spaces with ease. The force and temperature of the water must be controlled so that it may be varied to meet requirements of the individual cases. The over-all effect should be pleasant, refreshing and habit-forming."

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ARNIM, Sumter S. Dental irrigators for oral hygiene, periodontal therapy and prevention of dental disease. J. Tenn. S. Dent. Assn. 47:1-29 Apr. 1967.

"It is no more likely that we could disinfect a pyorrhea pocket by injecting the endamebacide into it than it is that we could disinfect it of bacteria by washing it out with an antiseptic solution, a thing that could not be expected. Washing out pyorrhea pockets with some harmless, non-irritating fluid, preferably physiologic salt solution, however, would undoubtedly be of value and would facilitate healing. Washing out the pockets would remove food particles that would otherwise decompose, accumulations of bacteria that sometimes form considerable masses, pus and debris as well as some endamebae."

BASS, C.C. and Johns, F.M. Alveolo-dental pyorrhea. Philadelphia, 1915 pp. 130-131 W. B. Saunders Co.

"This investigation was designed to compare and contrast the affects of two oral irrigators, Water Pic (pulsating) and Dento Spray (non-pulsating), on the inflamed gingiva of scaled and unscaled Beagle hounds. With its high incidence of calcareous deposits, the Beagle is an excellent animal for the investigation of periodontal disease. Evaluation was accomplished by clinical and histopathological examination; there was an extremely high degree of correlation between the two. Oral irrigation by two commercial appliances reduces oral inflammation in Beagles. The pulsating and non-pulsating pressures of the respective commercial irrigators are clinically and histopathologically comparable in reducing oral inflammation. Oral irrigation is approximately twice as effective as manual scaling in reducing oral inflammation. Greatest reduction in oral inflammation occurs when manual scaling and oral irrigation are combined in a dental health program."

BEGET, B.C. and Bram, M. Oral irrigation and inflammation. I.A.D.R. Abstracts, #4 p. 36, 1967.

"The use of hydrotherapy is effective in removing the accumulations of bacteria and other debris from teeth and gingiva. It is essential for the profession to recognize the importance of the dental microcosms in the etiology and pathogenesis of dental disease. The classical oral physiotherapy techniques often fall short of dislodging this highly motile microcosm. The eco system - the relationship of bacteria to each other - must be disturbed. Bubbling water from an irrigator, or using an electrically powered pump will certainly help achieve this objective. In a recent blind study completed by Drs. Karlan, Montana and author, 31 cases studied. Fifty percent of the control group had recurrence of necrotizing ulcerative gingivitis after one month, whereas only ten percent of the

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Water Pik users had a recurrence after a similar time. Results with the Dento-Spray were difficult to analyze due to the higher number of non-users. (Only 45 percent of patients used their faucet devices of the patients used, whereas over 90 percent used their Water Piks.)"

BERMAN, Charles L. What is the value of water spray devices in maintaining adequate oral hygiene? J. Western Soc. Periodont. 14:151-152 Dec. 1966.

"This study deals with the effect of water jets at 70,100,150 and 200 PSI on four oral mucosal sites of varying density. The mucosal areas used were the tongue, the mucobuccal fold and the attached gingiva of the rat and the attached gingiva and the marginal gingiva of the dog. It was shown that the tissue response to water jets is determined by the force of the jet as well as by the density and the mobility of the mucosa. It is suggested that the use of a water jet at 70 PSI is safe when used on the attached gingiva, but in areas such as the floor of the mouth, the mucobuccal fold, or in areas of ulceration pressures of 70 PSI or higher may produce reversible traumatic changes." ("Whereas the commercial water devices deliver a water jet at a maximum of about 70 PSI, an instrument was specially designed which emitted a water jet at a force which could be adjusted from 1 to 200 PSI.")

BHASKAR, Surindar N., Cutright, Duane E. and Frisch, Joe. Effect of high pressure water jet on oral mucosa of varied density. J. Periodontology-Periodontics 40:593-598 Oct. 1969.

"This study was conducted to determine effect of water lavage on open and primarily closed infected wounds of the orofacial area. The left side of the face was shaved in 56 rats, surgical wounds were created in the masseter muscle and infected with moist soil containing *Proteus mirabilis*, and *Klebsiella pneumoniae* in equal concentrations. Animals were then divided into four groups of 14 animals each. In Group I) the wounds were left open, in Group II) the area was lavaged and wound left open, in Group III) the wounds were sutured and in Group IV), the wounds were lavaged prior to primary closure with sutures. Histologic, bacteriologic and clinical observations showed that under the conditions of this study, water lavage was beneficial in reducing the bacterial contaminants and further that water lavage followed by primary closure produced faster healing than the other methods tested."

BHASKAR, Surindar N.; Cutright, Duane E. and Gross, Arthur Effect of water lavage on infected wounds in the rat. J. Periodontology-Periodontics 40:671-672 Nov. 1969.

"The use of the syringe gives a sense of cleanliness and comfort not obtainable in any other way. It is well worth the effort expended for

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this purpose alone, and persons who once learn this use of the syringe will gladly continue with it indefinitely. But in addition to this, it is really the best aid as a cleaning agent which we have."

BLACK, G.V. A work on special dental pathology devoted to the diseases and treatment of the investing tissues of the teeth and the dental pulp. Chicago, 1915 pp. 180, 433-436 Medico-Dental Publishing Co.

"Twenty-seven interdental gingival septae were obtained from 20 patients under treatment for periodontitis. After initial biopsy, patients were instructed in the use of the water pressure cleansing device (Water Pic) and the Modified Stillman Method of toothbrushing. Twenty-six experimental sites were re-biopsied five weeks after initial surgery. Use of Water-Pic was discontinued and five weeks later, twelve of these 26 sites were excised again. In an additional group of 15 patients, 20 cols were excised initially and the patients were instructed in the Modified Stillman toothbrushing technique. These sites were biopsied after five weeks and served as controls. When compared with initial specimens, a statistically significant decrease in inflammation was noted at the central col depressions of biopsies obtained after the cleansing device had been employed over a one month period. Tissues obtained from the same sites one month after using the cleansing device was stopped, showed no significant difference in inflammation compared with that observed in the first month posttreatment biopsies."

CANTOR, M.T. and Stahl, S.S. Interdental col tissue responses to the use of a water pressure cleansing device. J. Periodontology-Periodontics 40:292-295 May, 1969.

"This study examined the effectiveness in humans of water pressure device (WPD) in removing soft debris attached to teeth. The vestibular surfaces of the maxillary right cuspid and bicuspid teeth were used as the experimental area, with corresponding tooth surfaces in left maxillary areas as the control. Debris was measured by scores used in Greenes' Debris Index. Patients were instructed in the use of the WPD to be utilized on experimental areas only. Disclosing tablets used to stain the debris. Scores were recorded after initial staining; after use of WPD; and after restaining.....In this study the WPD was found to be 5.9 percent effective in the experimental area."

CLYNES, James T. and Wilderman, M.N. Effectiveness of water pressure device in removing debris attached to teeth. I.A.D.R. Abstracts, 1969 (Also J. Public Health Dent. 30:2-6 Winter, 1970.)

"A simple and colorful test to demonstrate the benefit of oral rinsing has been described. Test results have indicated that three or four rinses immediately after eating can eliminate appreciable amounts of retained sugar....Three adult males were each tested four times approximately 50

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additional subjects were tested once....Test: After eating candy, subject rinsed for 15 seconds with 15 cc. distilled water. Rinse water collected and procedure repeated three or four times with no time interval between rinses. Five drops from each rinse, plus one drop of 3 N hydrochloric acid put in test tube and heated one minute in boiling water bath. Each sample diluted with nine drops distilled water and urine sugar test tablet added."

COYKENDALL, Alan L. Swish and swallow is effective. J. Dent. Child. 33:162-163 May 1966.

"An irrigator, or dental spray, is not perfect in its action, but more effective than any other single procedure because it forces a stream of solution under pressure around the individual teeth and into the depth of the periodontal pocket. Thus we have an irrigating or flushing action that tends to wash out the irritating organisms daily, therefore reducing the invading army at least to the extent that the normal body defenses can gain control. Many sprays on market, but least expensive is the old bracket table bulb water syringe available from any dental supply company. It fits into bathroom cabinet, easy to use, user can mix any solution, with temperature to suit individual.....a high percentage of periodontal disease results primarily from the chronic irritating effects of multitudes of mixed organisms and their toxins that exist in the ideal environment of the periodontal pocket.....All oral hygiene routines are beneficial but it is believed the most efficient single procedure is the easy to use rubber bulb syringe irrigator used daily to flush the pockets of organisms, food particles and stagnated saliva."

CROWSON, D.L. The irrigator: an aid to home care of periodontal disease. J. Miss. D. Assn. 16:62-63, Apr. 1960.

"Eight adult patients who exhibited deep, relatively similar periodontal pockets were used. No scaling, curettage or polishing was attempted. Tissue specimens were obtained by gingivectomy with base of the excision on bone. When control site healed, 'Water Pik' given to patients with instructions as to use. No suggestions given regarding toothbrushing. From clinical and microscopic evaluation of this tissue, it would appear that the device is effective in the marginal portion of the pocket but not effective in the deeper portion."

CRUMLEY, Philip J. and Sumner, Chas. F., III. Effectiveness of a water pressure cleansing device. Periodontics 3:193-195 July-Aug. 1965.

"An experiment was carried out to evaluate the removal of stainable material from the maxillary anterior teeth of ten human subjects. The oral physiotherapy techniques evaluated were water pressure irrigation

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and toothbrushing. (Water Pik) The results were analyzed by standardized photograph and gram staining of stained material. 1) Results showed that only 8.1 percent of the stainable material was removed by water pressure irrigation and 67.6 percent of the stainable material was removed by toothbrushing. 2) Microbial smears showed no notable change in the gram staining properties of the stainable material after the use of the water-irrigation or toothbrushing when compared to the smear of the original stainable material."

FINE, Daniel H. and Baumhammers, A. Effect of water pressure irrigation on stainable material on the teeth. J. Periodont. 41:468-472 Aug. 1970.

Fifty-two routine dental patients participated in pilot study. Two groups - One group brushed with a conventional toothbrush; the other group used a toothbrush that emitted four small jets of water from between the bristles during the period of brushing. No dentifrice was used by either group, nor were any instructions given. Before brushing, each patient received an application of basic fuchsin stain to all surfaces of the teeth and was asked to rinse once; then a debris index was taken by the method of Greene and Vermillion....."Twenty-four patients using the regular toothbrush showed an average decrease in the index of 13.5 percent. Twenty-eight patients using the water-jet toothbrush showed an average decrease in the index of 29.3 percent. The t value of 3.5 with 50 degrees of freedom is a strong indication that the addition of water under pressure to the toothbrush during the brushing procedure produces a significant increase in the efficiency of the toothbrush in removing plaque."

GOLDEN, Irwin B. and Collins, Edwin M. Comparison of plaque removal by two methods of toothbrushing. Southern Calif. S.D.A.J. 32:71-72 Mar. 1964.

"Twenty-five Freshman dental students were asked to chew and expectorate a test meal of radio-iodinated peanut butter on a graham cracker, and the radioactivity remaining in their mouths was measured with a wide angle scintillation counter. They were then asked to brush their teeth by one of two methods (conventional or the waterjet toothbrush) for 30 seconds and the radioactivity remaining in the mouth was again measured. The same subject then chewed another test meal and repeated the procedure using the alternate method of brushing. The group average was 12.1 percent of the test meal remaining in the mouth after using conventional brushing; 6.3 percent remaining after using the water brush. To the extent that food clearance is a hygiene problem in any given mouth, it would seem from this study that the water brush is significantly superior to the conventional brush as an instrument for achieving oral hygiene."

GOLDEN, Irwin B.; Collins, Edwin M. and Deeb, Paul H. A comparative study of the clearance of radio-iodinated (I131) peanut butter and crackers from the mouth by two methods of toothbrushing. J. Periodont. 35: 495-497 Nov.-Dec. 1964.

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"This investigation of 380 albino rats deals with the comparative effect of pulsating water jet lavage at 70 psi and conventional bulb syringe irrigation on wounds infected with *S aureus*, *P mirabilis*, *P aeruginosa*, and *K pneumoniae*. It revealed that: the use of a pulsating jet delivered at a pressure of approximately 70 psi (4gm/mm<sup>2</sup>) showed a statistically significant reduction in the incidence of infection; it was superior to the conventional bulb syringe in the debridement of contaminated wounds; *S aureus* was more resistant to pulsating pressure water lavage and *K pneumoniae*, *P aeruginosa*, or *P mirabilis*. Water jet lavage of infected wounds offers promise in the immediate management of combat wounds."

GROSS, Arthur; Bhaskar, Surindar N.; Cutright, Duane E; Beasley, Joe D., III and Perez, Bienvenido. The effect of pulsating water jet lavage on experimental contaminated wounds. J. Oral Surg. 29:187-190 Mar. 1971.

"Experiments conducted by the United States Army Institute of Dental Research (Bhaskar, May, 1968) and others show that water spray devices will remove materia alba and food particles from the teeth but will not remove bacterial plaque. Use of water spray device by a group of Navy personnel (Peterson, W.A., et al, J. Periodont. 39:335, 1968) did not show any positive results. Chewing gum and 'detergent foods' do not remove bacterial plaque below the height of contour of the tooth."

HATTLER, Arthur B. and Summers, Robert B. What you should know about bacterial plaque. Pennsylvania D.J. 38:16-19 July 1971.

"Report concerns a clinical comparison of effectiveness of a pulsating oral irrigational device to the oral hygiene routine of 48 well-motivated treated, periodontal patients. All started with a zero calculus and plaque score. Group I issued a new hand brush and interdental stimulator and instructed in their use. Group II given the hand toothbrush, stimulator and irrigational device and instructed in their use.....Three months later patients reexamined and the periodontal calculus and plaque index recorded. One month later groups reversed for second phase of study. Results showed that the addition of the irrigational device significantly reduced the periodontal index as well as amount of plaque and calculus accumulation over a three month period."

HOOVER, D.R.; Robinson, H.B.G.; Jacobson, L. The comparative effect of a pulsating irrigational device as an adjunct in maintaining oral health in treated periodontal patients. I.A.D.R. Abstracts, 1968.

"Fifty-eight subjects evidencing moderate to severe periodontal disease were utilized. Thirty-two were given the device without an instruction in its use. Twenty-six were used as controls. At the end of three months all subjects were reexamined. Those using the device showed an average reduction of 38.3 percent in plaque index and 22.8 percent re-

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duction in inflammation. No change in calculus formation was observed. No periodontal abscesses developed and no pain was experienced during the use of the device. Subjectively, patients in the experimental group felt that their mouths felt better."

HOOVER, Donald R.; Robinson, H.B.G and Billingsley, A. The comparative effectiveness of the Water-Pik in a non-instructed population. J. Periodont. 39:43, 1968.

"Thirty-nine treated periodontal patients were selected to participate in this study on the basis of interest in and evidence of effectively following good oral hygiene habits. All patients were given thorough prophylaxes and then, at random, assigned to use oral irrigators (Water Pik), toothbrushes and interdental stimulators or toothbrushes and interdental stimulators only for a period of 90 days. The groups were then reversed after one month period for an additional 90 day period. The results showed that the groups incorporating the oral irrigator into their oral hygiene routine significantly reduced the periodontal index, as well as the amount of plaque and calculus accumulation over a three month period as compared with those using the toothbrush and interdental stimulator without the oral irrigator."

HOOVER, Donald R. and Robinson, Hamilton B.G. The comparative effectiveness of a pulsating oral irrigator as an adjunct in maintaining oral health. J. Periodont. 42:37-39 Jan. 1971.

"Tests were made to determine the effectiveness of an oral irrigating device in preventing an increase of microbial flora in patients wearing orthodontic appliances. Results indicate that toothbrushing and use of the oral irrigating device were 80 percent more effective than toothbrushing and rinsing in reducing the total aerobic flora and 60 percent more effective in reducing the lactobacillus count in orthodontic patients."

HURST, J.E. and Madonia, J.V. The effect of an oral irrigating device on the oral hygiene of orthodontic patients. J.A.D.A. 81:678-682 Sept. 1970.

"Water irrigating devices (WID) have become extremely popular oral hygiene aids in this country during the past decade. Their primary function is to remove debris by means of their flushing or lavage action. WID can be classified into two categories: 1) the pulsating type, powered by its own motor and pump with a variable pressure control and containing a liquid reservoir; and 2) the continuous-flow type which is attached to a faucet with pressure and temperature controlled by the water valves. The American Dental Association Council on Dental Materials and Devices stated in 1967 that the WID may be useful as an adjunct to the toothbrush in removing loose oral debris and improving oral hygiene; however, there is no



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evidence available at this time that would support any claims regarding treatment or prevention of oral diseases.....All authors (Arnim, 1967; Goldman and Cohen, 1968; Bohannon, 1965; Wilderman, 1966; Grant, Stern and Everett, 1968; Sumner, 1966; and Slatten, 1950) seem to agree that WID will remove food debris. This effect is most beneficial in cases of fixed bridges (Hagerman, 1955), orthodontic appliances, and the maintenance phase following periodontal therapy (Goldman and Cohen, 1968). Slatten (1950) advocated their use where there are malposed teeth, rampant caries, surgically exposed areas, acute gingival inflammation, and for individuals who have impaired manual function.....Arnim speculates (1967) that food debris in the mouth must go into solution and penetrate into the well-organized adherent bacterial mass before it can be metabolized by resident organisms to form toxic products of etiologic significance. He says the beneficial effects of WID are associated with a disturbance of the mucoidal gel barriers and microcosm metabolism. Arnim therefore implicates both 'discharged serums' (crevicular fluid), and food debris in supplying the nutrients for the metabolism of the plaque".....Author reviews studies by Wilderman, Toto, Dunkin, Tanaka, Bhaskar, Beget and Bram, Hazen, O'Leary, Krajewski, Giblin, and Gargiulo, Crumley and Sumner, Cantor and Stahl, Keyes, and others, and concludes with.... Water irrigation devices are effective in removing food particles and loose debris, and for this purpose are excellent oral hygiene adjuncts particularly for orthodontic patients and other patients with uncorrectable food retention problems. They also appear to effectively stimulate circulation in the tissues, although the benefit of stimulation is yet to be adequately documented.....At present there is no data to scientifically support any claims that the water irrigating device can reduce or alter bacterial plaque formation."

JANN, Robert. Water irrigating devices - literature review. Periodont. Abstracts 18:6-12 Mar. 1970.

Twenty-one dental students undergoing periodontal therapy - 20 to 34 day study. "Water Pik" used twice a day on left side as adjunct to brushing. Patients were evaluated before and after study in regard to amount of materia alba and plaque formation present. A decrease in materia alba and plaque (over and above that which could be attributed to brushing alone) of 6.2 percent was observed. Histologic portion conducted on ten patients who used "Pik" twice a day as an adjunct to brushing which remained unchanged on each side for one, three, five, six, ten, twenty and 25 day intervals. Biopsy specimens were taken using right side as control and left side as experimental side. A decrease in inflammation was shown in each case, with exception of one day specimen. All cases showed an increase in keratin layer thickness on the experimental side. The average increase in keratin thickness was 4.70 microns.

KRAJEWSKI, Joseph J.; Giblin, James and Gargiulo, A.W. Evaluation of water pressure cleansing device as an adjunct to periodontal treatment. Periodontics 2:76-78 Mar.-Apr. 1964.

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"Oral hygiene may be defined as that amount of preventive care necessary to eliminate the etiologic factors contributing to diseases of the periodontium. Recent studies have elevated the importance of microorganisms and their end products as prime culprits in the initiation of the pathologic process as we know it. Therefore, the role of physical irritation by gingival and subgingival deposits has been subordinated. Water pressure cleansing may aid in etiology elimination in three ways: 1) complete removal of dental deposits and microorganisms; 2) dilution of bacterial end products to a point of impotence, and 3) some removal of the pathologic pocket lining. The proposition that 'cleaning' subgingival calculus is, by itself, a form of cure is a dangerous assumption and is based on the premise that patients will continuously maintain the optimum degree of cleanliness. The roughened tooth or calculus surface is an ever present nidus for further deposition of plaque and is waiting for the first sign of neglect on the patient's part to re-initiate the pathologic process. Thus, in light of today's knowledge, we might say: An adjunct - yes, a substitute for the more conventional brush and floss - no!"

KRAJEWSKI, Joseph J. What is the value of water spray devices in maintaining adequate oral hygiene? J. Western Soc. Periodont. 14:151 Dec. 1966.

"Thirty gingival biopsy specimens were analyzed to determine the effect of water pressure on the clinically normal gingival sulcus. A 'Water Pik' was used to direct 320 cc. of water, full strength, into the experimental sulcus. A similar area on the opposite side of the mouth was used as a control. Experimental and control specimens were morphologically similar on the buccal and crevicular aspects of both the epithelium and connective tissue indicating that water pressure has no apparent effect on the non-pathologic gingiva. A few experimental specimens showed a slight degree of connective tissue hemorrhage at the base of the crevice."

KRAJEWSKI, Joseph L.; Rubach, Wm. C. and Pope, Joseph W. The effect of water pressure cleansing on the clinically normal gingival crevice. J. Calif. Dent. Assn. 43:452-454 Oct. 1967.

"Pulsar" attaches directly to combination hot and cold water faucets and is powered by the water in the tap. Manufactured by American Sun Mark Co., Danbury, Conn. Water temperature and water jet pressure are controlled by turning the faucet. The water from the faucet passes through a small turbine which creates the pulsating effect. The manufacturer has supplied the following pulse frequency table using oscilloscope measurements: Static Inlet Pressure 15, 20, 30, 40, 50, 60. Average Pulsar pulses per second 17, 22, 27, 31, 34, 36. Average United States faucet pressure - approximately 36 PSI. Summary: "One hundred eighty-seven patients were examined monthly for three months and indices recorded for gingivitis, debris, calculus, plaque and average pocket depth. The patients were placed randomly

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into four groups. I) served as control. II) used the Pulsar without specific instructions and III) used the Pulsar with specific instructions. IV) used the Water Pik with the same specific instructions as III). Groups II, III and IV showed a statistically significant (at .05 level) reduction in the mean scores for the gingivitis and mean pocket depth indices over I). The mean debris, calculus and plaque index scores (excluding IV) were reduced in the experimental groups as compared to the control group, but the differences were not statistically significant and may have been due to chance. II) showed a statistically significant reduction in the plaque index as compared to IV). The Pulsar used in Groups II and III was found to be equal in effectiveness to the Water Pick used in IV). No harmful effects to hard or soft tissues were noted with the use of either device."

LAINSON, Phillip A.; Bergquist, John J. and Fraleigh, Claud M. Clinical evaluation of Pulsar, a new pulsating water pressure cleansing device. J. Periodont. 41:401-405 July, 1970.

"Twenty patients used the Pulsar on one side of their mouths only for one month. Biopsy specimens were taken from both the experimental side and from the clinically similar opposite side and the histologic characteristics were rated in five categories. Ninety percent of the patients (18) showed a more nearly normal condition on the experimental side than on the control side in one or more of the rating categories. One patient showed no difference and another patient showed a less satisfactory condition on the experimental side. One patient had a foreign body reaction in both the control and experimental tissues, and another patient had a foreign body reaction on the experimental tissues only. No other unusual conditions were observed in any of the tissue samples."

LAINSON, Phillip A.; Bergquist, John J.; Tade, William H. and Fraleigh, Claud M. A histopathological study of tissue responses to the Pulsar pulsating water pressure cleansing device. J. Periodont. 42:101-104 Feb. 1971.

"Purpose of this clinical trial was to determine the effect of this device on plaque, calculus, and gingivitis. Non-dentally oriented females 17 to 21 years of age were assigned at random to three groups: I) Control, continued usual oral hygiene, II) New toothbrush, used new hand brush of their choice; III) Experimental, used new hand brush of their choice and Water Pik according to manufacturer's instructions. Statistical analysis of the data for 155 subjects showed a decrease in gingivitis for all groups during each experimental period. Group III) had a 50 percent greater reduction in mean gingivitis than Group I) or II) ( $p < 0.01$ ). Significant differences were found in mean increments of calculus accumulation among groups twelve weeks after prophylaxis. Group III had 50 percent less calculus than either Group I) or II)

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( $p < 0.01$ ). Mean scores for stainable plaque showed no differences in the quantitative accumulation of plaque among groups at any examination. No injury to hard or soft tissues or to dental restorations were observed or reported."

LOBENE, R.R. and Soparkar, P.M. Effect of a pulsed water pressure cleansing device on oral health. I.A.D.R. Abstracts, 1969.

"This study was designed to determine effect of water pressure cleansing device on oral health under conditions simulating the over-the-counter purchase of such devices. The findings reported tend to support the following conclusions: 1) Use of this device (Water Pik) was safe in the hands of the uninstructed since no damage of oral soft tissues or dental restorations was observed or reported during the course of this study. 2) The use of the Water Pik once a day to supplement toothbrushing significantly reduced gingivitis and calculus formation. 3) The use of a new hand toothbrush and the Water Pik had no effect on the accumulation of plaque either before or after dental prophylaxis."

LOBENE, Ralph R. The effect of a pulsed water pressure cleansing device on oral health. J. Periodontology-Periodontics 40:667-670 Nov. 1969.

"An experimental pulsating water pressure cleansing device was designed so that pump stroke, minute volume and pulse frequencies could be altered. Water jets in excess of eight grams of force (8,000 dynes) were generally painful to inflamed gingiva. The painful responses elicited with the use of the devices studied were independent of pump frequency. Water pressure cleansing devices should be designed so that the maximum forces the oral tissues will safely tolerate cannot be exceeded."

LOBENE, Ralph R. A study of the force of water jets in relation to pain and damage to gingival tissues. J. Periodont. 42:166-169 Mar. 1971.

"Photographs taken during a three-microsecond time interval have made it possible to study the cleansing action of a self-contained water spray device under simulated clinical conditions. (Water Pik Model 47) Within the range of conditions investigated it was found that regardless of the site of impingement of the water stream and of the angle or the distance of the spray tip from the oral structure, the action of the water spray was characterized by an impact and a flushing zone. Under proper control the potential ability of this action to remove food remnants, reduce the rate of accretion of dental deposits, and to stimulate the gingival tissues, should serve as a useful adjunct in providing and maintaining proper oral hygiene."

LUGASSY, Armand A. and Lautenschlager, Eugene P. Water spray cleansing action in oral hygiene. Am. Dent. Hygienists' Assn. 45:51-53, 4th Qtr. 1970.

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Five pulsating and four continuous commercial water spray devices were evaluated: Self-contained pulsating: Olympus Oral Clean; Pro Jet-stream; Water Jet; Water Pik. Faucet-attached pulsating: Pulsar Model 70. Faucet attached nonpulsating: Dento-Spray; Hydro-Brush; Hydro-Dent; POH Oral Water Spray. Conclusions: "Nine water spray devices were characterized according to rate of water discharge, rate of pulsation, force of spray, velocity of spray, stream shape and spray action and damage to a zinc phosphate cement. The rate of discharge was measured by collecting the volume of water discharged per unit time. The rate of pulsation was measured with a synchronous flashing stroboscopic light source. The force was measured at right angles to a load cell, and the velocity was determined with the aid of a ballistics equation. The cement damage was estimated through long testing time weight loss, whereas the remaining aspects of water action and stream shape were observed by high speed photography. The results showed that spray force, velocity, discharge rate and rate of pulsation all depend on dial or faucet setting. It was felt that several of the devices may produce damaging forces at their maximum settings. All devices produce turbulent, somewhat pulsating streams that produce zones of impact and flushing. They do not appear to damage zinc phosphate cement excessively even with extended use of the water spray."

LUGASSY, A.A.; Lautenschlager, E.P. and Katrana, D. Characterization of water spray devices. J.D.Res. 50:466-473 Mar.-Apr. 1971.

"There have been reports of acute exacerbations after use of irrigating devices. Study was designed to determine if water from devices enters the crevicular space and tissue. India ink, 10 cc. per 100 cc. of water, served as marker. Gingiva from 28 molar teeth of beagles served as test sites. Twenty-five patients requiring gingivectomies participated. Each area was irrigated for ten seconds from distance of  $3/8$  to  $1/2$  inch. Oral cavity rinsed and biopsy taken. Gingiva of twelve beagle molar teeth served as control areas. Water containing carbon was flowed over these areas for ten seconds. Areas were rinsed and biopsies taken. Sections were stained with Hematoxylin and Eosin, Eosin, and Melanin Bleach followed by Eosin. Carbon lined the crevicular epithelium in many sections. Six of ten animal sections, treated with a pulsating device, showed carbon in tissue. Three sections had particles of epithelium and connective tissue of two of eight human sections treated with device. It was in epithelium of four of eleven animal sections, irrigated by a valve controlled device. Carbon particles were in three of eight in epithelium and connective tissue; in third they were only in epithelium. Carbon was in epithelium and connective tissue of one of seven animal sections treated with a third device. It was present in epithelium and connective tissue of two of nine human specimens treated with device. Carbon lined the epithelium in some control sections but was not found in the tissue of any control."

O'LEARY, T.J.; Swenson, H.M.; Schafer, W.S. and Nesler, D.M. Penetration of fluid from oral irrigating devices into the gingival crevice and crevicular tissue: a preliminary report. I.A.D.R. Abstracts, 1969.

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Fifteen test subjects, 20 controls (submariners) re-examined three months after Water Pik units installed..."No significant benefit could be detected in the crew members using the appliance. The subject acceptance and motivation for the use of the instrument was questionable."

PETERSON, Wm. A. and Shiller, Wm. R. Unsupervised use of a water spray device by Naval personnel. J. Periodont. 39:335-337 Nov. 1968.

"Various authors have expressed concern over the pressures exerted by pulsating-jet oral irrigators and the possibility of resulting injury to the tissues (Karjewski et al., 1966; Sumner, 1966). Berman (1966) mentions injection through the oral mucosa by one of these instruments. The author has heard a clinician mention treating infections which followed the use of oral irrigators. Penetration of the oral mucosa by the irrigating solution would mean actual inoculation of the tissue. A search of the literature has not disclosed any attempt to evaluate penetration or even a technique for evaluating possible tissue penetration. ....It is necessary to label the irrigating solution with a material which possesses specific properties. The label must be soluble in water; it must not migrate in the tissues; and it must be able to withstand decalcification and histological processing and still remain visible..... One compound was found to be far superior to all others tested. This was a one percent solution of alcian blue."

SELIGER, W.G. A technique for measuring the penetration of pulsating-jet oral irrigators. Archs. Oral Biol. 14:435-436 Apr. 1969.

Author's conclusions after observing several hundred of his patients who have used the Dento-Spray or Water Pik over a period of two years..... "Both devices are effective in removing food debris from teeth and gums to a degree far superior to rinsing. Neither device will remove plaque. They will not adequately irrigate the periodontal pocket and so cannot be considered a substitute for pocket elimination in control of periodontal disease. In 1920 C. Edmund Kells suggested that a safe water pressure would send a stream of water from one end of the bathtub to the other end. At this time, 50 years later, with 'half a million people' using the devices, we know no more than did Kells about the desirable safe pressure for healthy or diseased tissue.....Conclusion: Devices will remove material alba and food debris and because they are easily and enthusiastically used by the patients, they are an excellent adjunct in our hygiene program. The biggest present disadvantage is that they too frequently are used as a substitute for effective plaque removal techniques."

SUMNER, Charles F. What is the value of water spray devices in maintaining adequate oral hygiene? J. Western Soc. Periodont. 14:150 Dec. 1966.

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"Oral water irrigation is not new as it was recommended by using a bulb syringe by G.V.Black in the early 1900's. The work done by Arnim and associates probably stimulated the current interest in hydrotherapy..... One is concerned that water pressure could conceivably drive bacteria into the gingival tissue resulting in bacteremia. A study by Tamimi et al., showed that no bacteria was discernible following the use of a pulsating device. At Indiana School of Dentistry a study was undertaken with carbon particles incorporated in the water and utilized on a patient prior to a gingivectomy. This tissue was removed on the day of irrigation, a week later, two weeks later and three weeks later. In all instances carbon particles were found buried in the connective tissue of the gingiva. Whether this is of clinical significance has not been determined but it does show the possibility of driving foreign matter into the gingiva with these devices. In an oral report Sumner stated that he had twelve patients on a water irrigating device for a year and three of these developed a lateral abscess.....Clinical trials for the removal of plaque by water irrigating devices has been found to be ineffective when toothbrushing and flossing were discontinued.....If one will eat a chocolate brownie, brush the teeth and then use a water irrigating device and catch the droppings in a tea strainer, numerous chocolate crumbs may be seen that were not removed with the toothbrush. This, however, is not necessarily true if this is done two or three hours after eating.....One can conclude that water irrigating devices may be an adjunct to oral health. I believe they are indicated for patients who have fixed bridge work which restricts flossing, those with orthodontic appliances or malposed teeth. The patient should be instructed that a moderate amount of pressure should be used and that the stream of the water should be directed perpendicular to the long axis of the tooth. This will reduce the possibility of damaging the gingival tissue. Further research is necessary to determine the long range effect of these devices."

SWENSON, Henry M. ABC's of periodontics -- "W" is for water irrigating devices. J. Indiana D. Assn. 49:428 Nov. 1970.

"This study was undertaken to determine if utilization of an oral water irrigation device by subjects clinically free of inflammatory periodontal disease or by patients suffering from gingivitis or periodontitis would induce in these subjects a state of bacteremia detectable when 2.6 ml blood specimens were plated out on appropriate media and incubated under aerobic and anaerobic conditions. Thirty subjects, young healthy adults, highly motivated toward dental hygiene as members of Sophomore class of dental school.....In this study, there was no evidence that subjects clinically free of inflammatory periodontal disease or with gingivitis or periodontitis developed a bacteremia as a result of the use of this water irrigation device (Water-Pik)."

TAMIMI, Hamdi A.; Thomassen, Paul R. and Moser, Ernest H., Jr. Bacteremia study using a water irrigation device. J. Periodontology-Periodontics 40:424-426 July 1969.

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"One hundred sixty men (21 to 25 years of age) were used to collect saliva before and after using either a pulse-jet-spray of water or non-dentifrice toothbrushing for cleaning the teeth. An oral index was obtained before and after water jet washing or toothbrushing. The toothbrush more significantly cleans the oral debris from the teeth than does either low or high pressure pulsations of water directed to the teeth. However, either high or low pulsations of water significantly cleans the teeth of acidogenic microorganisms. They are at least as effective as the toothbrush in this respect. While careful brushing of the teeth will result in a reduction of oral debris, the use of a carefully applied jet spray of water, in addition to toothbrushing, can result in effective cleaning of the mouth of bacteria."

TOTO, Patrick D.; Evans, Charles L. and Sawinski, Vincent J. Effects of water jet rinse and toothbrushing on oral hygiene. J. Periodontology-Periodontics 40:296-298 May 1969.

"The answer to that question is that the dentist should prescribe the use of an oral irrigating device to those patients who need it for the maintenance of oral health following dental procedures designed to treat and return periodontally involved mouths to a state of oral health. They should not prescribe such devices for the normal healthy mouth - as there is a danger in the fact that a large number of patients who do not need such a device, or perhaps might need periodontal therapy, are using the device as a replacement for the toothbrush. The dentist must prescribe methods and devices for a particular patient. This should be done as a prescription since the same methods and/or devices will not suffice for all mouths."

WALKER, Fredrick E. Who needs an oral irrigation device? Chronicle of the Omaha District Dent. Soc. 32:46-48 Oct. 1968.

"The devices discussed in the article all have a liquid source either a faucet or a reservoir or container and a handle with a tip and an orifice in the tip. The continuous flow of the liquid at the orifice in the tip can be regulated at the water faucet to a force desired by the dentist or patient except in one instrument the liquid is propelled at regular intervals (pulsating) with a variable force that is controlled by the use of a pump and motor.....The claims in advertising to the dentist are not based on experimentation. Statements such as complete removal of every trace of debris on every tooth surface and in the gingival crevice has not been substantiated. Other statements, clean teeth thoroughly where the toothbrush can't reach, aid in treatment of mouth infections and pyorrhea, prevents erosion and abrasion of cavities, prolongs the life of the teeth and gums, checks bleeding gums due to soft diet or lack of stimulation, have not been thoroughly investigated.....It is question-



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able whether the water cleansing device as we know it today is adequate in fulfillment of the philosophy of EPHOP (efficient, personalized, home oral physiotherapy)."

WILDERMAN, M.N. An evaluation of water pressure cleansing devices. J. La. D. Assn. 23:5-7 Spring, 1966.

DENT-O-PICK - Troy Industries, Inc., 135 Marbledale Road, Tuckahoe, N.Y.  
 ORAL PICK - Iodent Chemical Co., 2233 Park Ave., Detroit, Mich. WATER  
 PIK - Aqua Tec Corp., 730 17th St., Denver, Colorado. DENTO-SPRAY -  
 Texell Products Co., 3 Asbury Pl., Houston, Texas. ORAL KLEEN - Avery  
 Sedell and Associates, 3025 W. Broward Blvd., Fort Lauderdale, Fla.....  
 "The committee is of the opinion that such a device using the motor-driven  
 principle or water faucet attachment may be useful as an adjunct to the  
 toothbrush in removing loose oral debris and improving oral hygiene; how-  
 ever, there is no evidence available at this time that would support any  
 claims regarding treatment or prevention of oral diseases."  
AUTHOR UNKNOWN: Council on Dental Materials and Devices. Irrigating  
 devices. J.A.D.A. 74:799 Mar. 1967.

"Since the devices themselves will not remove any plaque, that most harm-  
 ful of the three types of material collecting on or about the teeth, no  
 water device presently on the market can be considered a substitute for  
 those commonly used instruments of home care, which will remove plaque,  
 i.e., brush and floss....."The overall picture then, is one of im-  
 proved oral hygiene, but not improvement great enough to control periodon-  
 tal disease.....Clinically, there is no significant difference in  
 motor-driven devices and faucet pressure devices.....remembering no  
 pressure will remove plaque and that a moderate stream will remove food  
 debris, materia alba and dilute bacteria."  
AUTHOR UNKNOWN: Something new in oral hygiene appliances. (The current  
 status of water pressure devices) Consumer Bulletin, Apr. 1967, pp. 4-7.

".....newest wrinkle in automatic toothbrushes is a water-powered tooth-  
 brush. The appliance flushes out the space between teeth and under the  
 gumline with a pulsating stream of water. The device is described as a  
 'hydromechanical energy converter'.  
AUTHOR UNKNOWN: Odd facts about toothbrushes. So. Carolina Dental J.  
 27:18 Mar. 1969.

# IX. ADJUNCTS FOR ORAL HYGIENE (Floss, Rinses, dentifrices)

"This study consisted of microbial examinations of a number of specimens obtained from the oral cavity of a seriously ill patient with a preliminary diagnosis of erythema multiforme who was treated with many drugs, including antibiotics and steroids.....Results indicated that 1) certain microorganisms (streptococcus and neisseria specie) are either more resistant to numerous rinses with mouth washes and topical applications of antibiotics and other chemical agents or 2) these microorganisms are inhabitants of ecological niches which due to their location are not exposed to the above agents. These areas then remain breeding zones from which microbial replenishment of the saliva occurs. With the resolution of the lesions and the cessation of both local and systemic therapy the indigenous population again approximates in numbers and species that of a normal individual. It is also significant that a sterile oral cavity is unattainable by frequency of mouth rinses and the topical applications of various chemotherapeutic agents. This study presented a striking example of the serious concomitants of prolonged systemic drug therapy on the tissues and microbial flora."

BARTELS, Henry A.; Cohen, Gerson and Scopp, Irwin W. Alterations in the oral microbial flora accompanying local and systemic drug therapy. J. Periodontology-Periodontics 40:421 July 1969.

"Disclosing solutions are extremely simple to use and offer the dental practitioner valuable assistance, particularly in the areas of prophylaxis, and education of the patient in oral hygiene techniques. The importance of, and the need for better oral hygiene can be easily demonstrated to children as well as adults. These materials are also quite useful to the clinical teacher as a means of rather quickly determining the dental student's ability in performing supra-gingival prophylaxis."

BENNETT, Carol G. Disclosing solutions for pedodontics. J. Dent. for Children 31:131-134 2nd Qtr. 1964.

"In a one-month comparison of three measures commonly advocated for maintenance of oral hygiene in the field, results indicate instructed use of a balsa wood dental stimulator to be as effective as, but vigorous rinsing to be a poor substitute for, the uninstructed use of a toothbrush and dentifrice, as measured by the Russell Periodontal Index and the Green & Vermillion Simplified Oral Hygiene Index."

BERNIER, J.; Sumnicht, R.; Lancaster, J. and Monahan J. A comparison of three oral hygiene measures. J. Periodont. 37:5-11, July-Aug. 1966.

"In order to overcome monotony of the programs described (use of disclosing wafers, unwaxed dental floss, Dento-spray) stimudenting and flossing

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is encouraged while viewing TV or reading, leaving the actual brushing and use of Dentospray for the bathroom procedure. By overcoming the monotony of standing in the bathroom for the length of time necessary to accomplish the desired results, the percentage of patients doing a more thorough oral hygiene procedure is greater than we would find otherwise."

BLEADON, Samuel B. How to achieve a clean mouth. Acad. Rev. (Calif. Acad. of Periodontology) July 1963.

"Although periodontal disease afflicts over 95 percent of the world population, most of this can be prevented. The most important etiologic factor is thought to be the microbial masses that accumulate on the surfaces of teeth, and unless removed regularly, calcify to form dental calculus. An effective preventive program includes the regular removal of these masses, and can only be based on patient understanding and motivation. An armamentarium consisting of disclosing wafer, soft nylon toothbrush, unwaxed dental floss, and a water spray has proved to be effective in maintaining a satisfactory level of oral hygiene." (Note: X-Pose Wafer, POH Floss, Butler #411 brush, and Dento-spray recommended.)

BOHANNAN, Harry M.; Ochsenbein, Clifford; Saxe, Stanly R. Preventive Periodontics Dent. Clinics of No. Am. 435-443 July, 1965.

"Techniques are described for the evaluation of the abrasive and cleaning properties of toothpastes. For a series of toothpastes data are presented for enamel and dentine abrasion and the toothpastes ranked in order of cleaning. Comparison of the data for abrasivity and cleaning shows a good correlation between the in vitro and in vivo studies."

BULL, W.H.; Callender, R.M.; Pugh, B.R. and Wood G.D. The abrasion and cleaning properties of dentifrices. Brit.D.J. 125:331-337 Oct. 15, 1968.

"Without proper interproximal hygiene, all is lost." (Aids discussed: disclosing wafers, dental floss, Zon bridge cleaner, Vident Bodkin, Stim-u-dent, Crescent toothpick holder, rubber tips, plastic picks, pipe cleaners, gauze, yarn.) "Most recent addition are interproximal brushes. These brushes are made of nylon filament twisted in a stainless steel wire. This is placed in a biangle handle so that all interproximals can be cleansed. Brushes can be made in a variety of sizes and shapes. Simply by placing this brush interproximally and brushing, the problem of interproximal oral hygiene is solved."

BURNS, Robert L. The most neglected aspect of oral hygiene. Am. Dental Hygienists' Assoc. 42:34-35 1st Qtr. 1968.

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"Dental students and children formed the study population for this two-part investigation. In the young adults, dextranase had no statistically significant effect on plaque score. In the children, the mouthwash had no demonstrable effect on plaque formation."

CALDWELL, R.C., Sandham, H.J. Mann, W.V., Jr.; Finn, S.B. and Formicola, A.J. The effect of dextranase mouthwash on dental plaque in young adults and children. J.A.D.A. 82:124-131 Jan. 1971.

"Six dental students participated in two experiments throughout which they ceased all active oral hygiene measures. In the first experiment a two percent solution of chlorhexidine and in the second a placebo solution was applied topically each day to all teeth. Throughout both 15 day experiments the bacterial colonization of the attached gingiva, gingival margin and tooth surface was examined using impression preparations and a microcolony technique. Bacterial colonization of the tooth surface occurred rapidly using the placebo and a bacterial plaque accumulated at the gingival margin as described in previous no-oral hygiene experiments. No bacterial colonization of the tooth surface was observed throughout the chlorhexidine experiment. The bacterial flora of the attached gingiva remained unaltered, but at the gingival margin an increase in the numbers of gram negative cocci and rods occurred between days five and ten. A tendency was noted for this flora to revert back to gram positive by the end of the experiment. It is concluded that the inhibition of plaque formation by chlorhexidine is primarily a result of its ability to interact with the organic or inorganic components of the tooth surface."

DAVIES, R.M.; Jensen, S.; Børglum, Schiøtt; Rindom, C. and Løe, Harald. The effect of topical application of chlorhexidine on the bacterial colonization of the teeth and gingiva. J. Periodont. Res. 5:96-101 1970.

"The use of a chewing gum containing the pancreatin, viokase, reduced the occurrence of dental calculus for a group of 19 calculus-forming subjects by 24 percent in a split-panel test. The effect was statistically significant at the 0.01 level of probability. Further work is necessary to determine the level of effectiveness that can be achieved under optimum conditions of formulation, use and evaluation."

ENNEVER, J. and Sturzenberger, O.P. Inhibition of dental calculus formation by use of an enzyme chewing gum. J. Periodont. 32:331-333, Oct. 1961.

"Six hundred children from state school for deaf and blind. At end of two year study, 428 remained. Results.....on comparison basis, the dentifrice containing 0.76 percent of sodium monofluorophosphate, one percent sodium N-lauroyl sarcosinate and insoluble sodium metaphosphate permitted approx-

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imately 25 percent fewer new DF surfaces than a dentifrice containing either 0.4 percent stannous fluoride and calcium pyrophosphate or one with 2.0 percent lauroyl sarcosinate and dicalcium phosphate dihydrate. The reduction in dental caries of the fluorophosphate dentifrice was highly significant statistically."

FINN, Sidney B. and Jamison, Homer C. A comparative clinical study of three dentifrices. J. Dent. Children 30:17-25, 1st Qtr. 1963.

"Six-hundred six children at School for deaf and blind divided into three groups. Group 1) chewed sugar-containing gum; Group 2) sugarless gum; Group 3) sugar gum containing 225 mgs. dicalcium phosphate per stick. Each child chewed five sticks per day for 30 months. Considering the proximal surfaces only, there were significant reductions in all categories in the sugar phosphate group over the sugar group. A similar trend but one of less magnitude is revealed between the sugar and sugarless groups. When proximal surfaces of the posterior teeth only are considered, the phosphate gum group shows significant reductions of from 52.3 to 62.3 percent over the sugar group. Between the sugar and sugarless groups the differences are significant but of less magnitude (25.5 to 38.8 percent). The sugar-phosphate gum displays some superiority over the sugarless gum."

FINN, Sidney B. and Jamison, Homer C. The effect of a calcium phosphated chewing gum on dental caries in humans-thirty month results. I.A.D.R. Abstracts 1967.

"Purpose of study to determine the effectiveness of disclosing tablets as a motivational device in improving tooth brushing practices"..... Subjects: Two B7 health classes from each of eight Los Angeles Jr. High city schools. Five week program) Results:"The disclosing tablets seem to be a significant factor in motivating students to improve their tooth-brushing practices.....The use of disclosing tablets by groups of students in an instructional setting is associated with decreases in the amount of plaque. Instruction without use of tablets did not improve toothbrushing practices."

FODOR, John T. and Ziegler, J. Eugene A motivational study in dental health. J. So. Calif. St. Dent. Assn. 34:203-207 Apr. 1966.

"Among the few investigations with respect to the cleansing properties in different dentifrices a toothbrushing trial performed by Frostell and Coworder (1965) may be mentioned. They investigated the cleansing effect of toothbrushing with water and with toothpastes containing: silicon dioxide, sodium bicarbonate, calcium carbonate, calcium phosphate and acrylic grains, ie. the main types now being for sale. The measure

of the cleansing effect was based upon recordings of remaining plaques after toothbrushing by means of a disclosing agent and then according to plaque index (cf. Arnim, 1963). The differences between the dentifrices were denoted as insignificant. If the cleansing properties in grinding and non-grinding dentifrices respectively are measured by means of their capacity for removal of discoloured stains, the later type seems to be just as good as the former (Gerdin, 1970).

GERDIN, Per-Olof. Studies in dentifrices, III, The prevalence of gingival disease in children 12 to 14 years of age in relation to toothbrushing by means of different dentifrices. Swed. Dent. J. 63:605-620, 1970.

"In three previous studies some certain properties of commercial grinding and non-grinding dentifrices have been compared. As the effects of toothbrushing seem to depend on the different contents of the dentifrices used, a comprehensive knowledge of the ingredients in dentifrices is a necessary background for assessments of the causes of their different effects. The main contents of dentifrices are grinding and/or polishing particles....."

GERDIN, Per-Olof. Studies in dentifrices, IV: size and shape of particles in commercial dentifrices. Svensk Tändlakare Tidskrift 64:447-461, NR 7, 1971.

"The chlorhexidine-containing toothpastes showed stronger antibacterial activity against salivary bacteria in vitro than the commercial dentifrices. It is concluded that the method used for testing the plaque-inhibiting effect of dentifrices may be useful and that it is possible to maintain the plaque-inhibiting effect of chlorhexidine previously described in several mouthrinse experiments when a toothpaste is used as a vehicle for the agent."

GJERMO, Per and Rølla, Gunnar. Plaque inhibition by anti-bacterial dentifrices. Scand. J. Dent. Res. 78:464-470, 1970.

The plaque inhibiting effect in vivo of eleven antibacterial agents was compared with their antibacterial activity against salivary bacteria in vitro. The in vivo effect was tested four days in humans with sucrose supplement in the diet. Chlorhexidine gluconate and acetate prove most effective in vivo whereas several other substances equally or more effectively inhibited salivary bacteria in vitro, exhibited no effect in vivo. Other factors than antibacterial properties are important in plaque inhibition in vivo.

GJERMO, Per; Baastad, Kirsten Lyche and Rølla, Gunnar The plaque-inhibiting capacity of eleven antibacterial compounds. J. Periodont. Res. 5:102-109, 1970.

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"Three experimental studies were carried out to compare the effect of different implements recommended for interdental cleaning. In young adults with healthy periodontal tissues, dental floss was superior to toothpicks in removing plaque from the lingual parts of the interproximal surfaces. The use of a single-tufted brush as a supplement to the toothpicks compensated for the lack of effectiveness of toothpicks alone. In wide-open, interproximal areas, following periodontal destruction, the interdental brush is the most suitable implement to remove bacterial plaque."

GJERMO, Per and Flotra, Leiv. The effect of different methods of interdental cleaning. J. Periodont. Res. 5:230-236, 1970.

"If space travelers are to maintain oral hygiene during prolonged flights, a dentifrice that can be used, then swallowed, is a necessity. An ingestible toothpaste was tested during a simulated space flight by four young male adults who spent 43 days in a space cabin simulator at a pressure equivalent to 27,000 feet of altitude. Although at first they found it difficult to get accustomed to the taste as well as the necessity of swallowing the debris and dentifrice, the subjects found the toothpaste acceptable after the initial strangeness."

HALL G.L.; Jerman, A.C. and Brown, C. E. Acceptability and effectiveness of an ingestible toothpaste. School of Aerospace Medicine Reports, SAM-TR-69-84 Dec. 1969. (Abstract from Dental Student 48:14 Apr. 1970.)

"The clinical trial of calcium sucrose phosphate used as a food additive for a period of three years in 527 children (Control 361, Treatment 166) aged five to 17 years demonstrated a lower incidence of dental caries for those children receiving the additive. The results reported previously for the first two years of trial have been confirmed after three years and this has been demonstrated by statistical significance in a number of cases. In the age group nine to 13 years there are reductions for the Treatment Group of : DMF teeth 15.3 percent, DMF surfaces 17.9 percent. DMF proximal surfaces 29.5 percent. Strong evidence supports earlier findings that most benefit is gained on proximal surfaces which accounted for approximately 40 percent of all lesions found." (The medical investigations showed no differences in the physical status and general health between the children of the Control and Treatment Groups.)

HARRIS, R.; Schamschula, R.G.; Beveridge, J. and Gregory, G. The cario-statis effect of calcium sucrose phosphate in a group of children aged 5-17 years. Part IV. Australian D.J. 14:42-49 Feb. 1969.

"The value of a dentifrice in plaque removal has been shown by several investigators. (Muhler, J.C. J. Periodont. 35:481 1964). A dentifrice

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with both a detergent and abrasive is necessary for plaque removal. Toothbrushing with water or bicarbonate of soda and sodium chloride has no value over the mechanical action of the bristles themselves." HATTLER, Arthur B. and Summers, Robert B. What you should know about bacterial plaque. Pennsylvania D.J. 38:16-19 July 1971.

"When supervised toothbrushing with therapeutic dentifrice is combined with periodic use of disclosing tablets to illustrate how well or poorly the child has brushed his teeth, the teacher has an excellent opportunity for dental health education. The resultant reduction in dental caries and periodontal disease will also have a positive effect on the treatment component of the school dental health program." HAYDEN, Charles H. Preventive dental procedures adaptable to school health programs. Am. J. Public Health 59:522-526 Mar. 1969.

Author states floss alone does not provide a sufficiency of frictional area to attain the efficiency of the gauze strip. "The gauze strip is used in conjunction with disclosing tablet or solution to reveal the plaque the strip is to dislodge. The technique should be conducted under the close surveillance of the dentist.....if used in an injudicious manner, clefting of tissue, abrasion of teeth and unnecessary tooth movement can result."

HINDSLEY, Frank W. The interdental gauze strip - an aid to oral health. New Mexico D.J. 20:11-13 Nov. 1969.

(Lactona No. 8 toothbrush, and Masti-Clean, Ethical Products Division, Industrial Electronic Rubber Co., Twinsburg, Ohio.) "Masti-Clean is made of a synthetic rubber and is composed of a semiflexible handle supporting a removable section of foamed sponge. The rationale of operation of the Masti-Clean is a mechanical scrubbing action combined with a hydraulic flushing effect created by the forces of normal mastication.....Thirty-seven children selected from Crippled Children's Hospital in Dallas, most had entered the hospital to receive a surgical operation - children considered to be mentally retarded were not used in this study.....The difference between the scores of children using the Masti-Clean and children using the toothbrush was not significant statistically at either the first or second examination. The general improvement in oral cleanliness by both groups is attributed to pre-test oral prophylaxis, enthusiasm toward project and novelty of Masti-Clean.....This study indicated that the type of occlusion has direct effect on cleanliness of the children's teeth. Children with ideal occlusions had cleaner mouths than children with obvious malocclusions or anterior and/or posterior crowding." HOLCOMB, Ferrin H.; Taylor, Paul P. and Saunders, William A. Comparison of two oral hygiene devices for the physically handicapped. J. Dent. Child. 37:325-330 July-Aug. 1970.



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"Siwak" is an Arabic word meaning both to massage with a wooden stick and the stick used for such a purpose.....used by the followers of Islam - one of the oldest and most effective tools of oral hygiene. This stick, from shrub stem or root found in Middle East, is soaked in water until fibers separate.....The functioning end is brought against the lower gum with the fibers directed horizontally; then it is moved in a rotary fashion upwards until it contacts the gum of the upper jaw; then it is worked between the teeth using a horizontal motion....."The author has treated ten patients who regularly use the Siwak, and their characteristic dentition showed the marked abrasion on the labial or buccal aspects of their teeth with variable amount of recession. There was little dental caries and two of these patients had their full complement of teeth after the age of seventy."

HUSSEIN, Issa. Use of the Siwak in Islam. Brit.D.J. pp.189-190 Feb. 15, 1966.

"This study is third in series investigating the removal of natural plaque on the mesial interproximal surface of lower first molars in contact with second bicuspid. Removable tooth slabs inserted in full gold crowns were utilized on seven patients. A four-day plaque was used and photographed. The plaque was additionally studied by measuring the light reflected by the tooth slab and plaque; illumination was standardized and reflected light recorded by a photo cell mounted in a dissecting microscope. Kodachrome slides were made of the slabs at various stages of the experiment and projected using standardized magnification. Plaque covered areas were traced and measured with a polar planimeter. Prior experiments showed that the most efficient cleansing method for the interproximal surface was a combination of brushing with a dentifrice and flossing. Cleansing methods studied in this experiment were flossing with wax floss, unwaxed floss and teflon yarn, and the use of rubber and balsa wood picks. The results were statistically analyzed. Significant differences were found between flosses and picks. The most efficient cleansing methods were flossing with waxed or unwaxed floss."

KELLER, S.E. and Manson-Hing, L.R. In vivo removal of interproximal plaque. I.A.D.R. Abstracts 1969.

"Considerable attention has been devoted to the possibility of using a phosphate food additive to control dental caries. Work on calcium sucrose phosphate (CaSP) has suggested that this compound satisfies the requirement for a food additive of effectiveness, safety, palatability and low cost. Clinical trial begun in 1963 using five percent CaSP added to a standard dentifrice. Children of both sexes age five to 16 years, used the dentifrices (unsupervised) for two years. Two hundred seventy-three controls, 294 in treatment group. The results were statistically inconclusive, although the treatment group showed an average of nine percent fewer DMF

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surfaces than the control group."

LILIENTHAL, B.; Gregory, G. and Wood B. A clinical trial of calcium sucrose phosphate in a dentifrice. I.A.D.R. Abstracts 1968.

"Low correlations between the abrasiveness of the dentifrices studied and their cleansing properties indicate that cleaning is not necessarily related to the abrasiveness of dentifrices.....A technic has been described for the rapid clinical evaluation of the stain-reducing properties of dentifrices with controlled conditions. Several dentifrices (Colgate and Macleans) did show superior stain reduction as claimed, and in addition, statistically significant differences in stain reduction were found among these products."

LOBENE, Ralph R. Effect of dentifrices on tooth stains with controlled brushing. J.A.D.A. 77:849-855 Oct. 1968.

In a controlled study of 17 college men, dextranase mouthwash was found to reduce significantly the dry weight of dental plaque that formed during a three-day interval on surfaces of freshly cleaned teeth.

LOBENE, R.R. A clinical study of the effect of dextranase on human dental plaque. J.A.D.A. 82:132-135 Jan. 1971.

"Twenty-four male dental students with healthy gingivae and clean teeth ceased all oral hygiene procedures. A) Four subjects rinsed twice daily with a 0.2 percent solution of chlorhexidine gluconate; B) Eight students rinsed, once daily, with same solution; C) Six students did not rinse and formed control group, and D) Six students received one daily application of a two percent solution of chlorhexidine gluconate."....1) Two daily ten ml. mouth rinses of a 0.2 percent solution of chlorhexidine effectively prevents plaque formation. 2) One daily mouth rinse with 10 ml. of 0.2 percent solution of chlorhexidine for 40 days did not effectively prevent plaque formation. 3) One daily application of a two percent aqueous solution of chlorhexidine for 15 days inhibited plaque formation.....Stain on the teeth and tongue appeared about day five in two times daily rinses and two percent aqueous application....."It is concluded that complete inhibition of plaque and prevention of gingivitis may be achieved by daily application of chlorhexidine, provided the agent is administered in such a way that it reaches all tooth surfaces."

LOE, Harald and Schiott, C. Rindom The effect of mouthrinses and topical application of chlorhexidine on the development of dental plaque and gingivitis in man. J. Periodont. Res. 5:79-83, 1970.

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"An office study was conducted to determine the state of observable dental hygiene in 256 children. A disclosing solution was used. There was little correlation between the home care claimed by the children and the observed results. Home dental care may be a myth. A disclosing solution is a valuable aid in determining the state of dental hygiene."

MACK, Edward S. and Kipnis, Mervyn The myth of home dental hygiene of children. J.A.D.A 65:520-522 Oct. 1962.

".....various pharmaceutical agents are considered from several aspects: the rationale behind their use; mode of action; clinical investigations; assessment of their efficacy and potential; and recommendations as to their use.....DENTIFRICES: Multiple brushing (by hand and with an unmedicated dentifrice) when instituted directly after each meal substantially reduces caries.....AMMONIATED DENTIFRICES: At the present time it seems that dentifrices containing five percent dibasic ammonium phosphate and three percent urea or urea and urease do not have any significant effect in reducing caries. Dentifrices containing high concentrations of urea (without urease added), on the other hand, have consistently been reported to reduce the incidence of new caries. In the better controlled studies, the reduction was about 25 percent.....ENZYME INHIBITORS: Sulser reported a 55 percent caries reduction using a dentifrice containing sodium dehydroacetate. There were 593 young adults in this two-year test. No other studies with this anti-enzyme agent have been reported.....ANTIBIOTICS: Since bacteria play a key role in the initiation and progression of caries, antibiotics would appear to be a logical adjunct in caries therapy. A penicillin dentifrice was tested in five trials with varying results.....In only one of the studies was caries significantly reduced.....Tyrothricin has been tested in a dentifrice in a clinical trial with 284 school children seven to 14 years of age. A 26 percent reduction in DMFS over a two-year period of supervised use was reported as compared with the controls. Although the side effects would be expected to be far less of a problem than with penicillin, substantial evidence of safety as well as further evidence of efficacy would be required before a tyrothricin dentifrice would be recommended.....FLUORIDE DENTIFRICES: Based on the reports to date, sodium fluoride appears to be completely ineffective in a dentifrice.....There have been eleven clinical studies of dentifrices containing stannous fluoride.....In eight tests, statistically significant reductions in DMFS ranging from 20 to 50 percent were reported.....The dentifrice with 0.76 percent sodium monofluorophosphate permitted approximately 25 percent fewer new DF surfaces after two years than did the other two dentifrices (which were about equal in their ability to reduce caries). This difference was reported to be statistically significant.....In the one clinical study reported to date on organic fluoride dentifrices, five dentifrices, three of them containing amine fluorides were compared as to their effect on caries increment in the permanent teeth in seven and twelve year old children over a period of 18 months. A reduction in new caries of around

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25 to 30 percent was noted for the amine fluoride preparations."

MANDEL, Irwin D. and Cagan, Richard S. Pharmaceutical agents for preventing caries - a review. J. Oral Therapeutics and Pharmacology 1:218-227 Sept. 1964.

"Distilled water was ineffective in reducing oral bacterial counts. The commercial mouthwash formulation (antiseptic mouthwash and gargle containing 15 percent alcohol, dequalinium acetate, cetyl pyridinium chloride, oil of peppermint and menthol) caused an initial precipitous and almost complete reduction in the oral microbial population. Direct evidence of the suppression of the oral population was observed over the eight hour experimental period following a rinse with the commercial mouthwash formulation. Direct evidence was found for the presence of antimicrobial agent in the mouth as long as four hours after rinse with the commercial mouthwash formulation." (Forty-nine subjects, 78 individual microbiological runs, June 12, 1961 through July 25, 1961)

MANHOLD, J.H., Jr.; Parker, Leroy A. and Manhold, Beverly S. Efficacy of a commercial mouthwash: in vivo study N.Y.J.Dent. 32:165-171 May 1962.

"Toothpaste containing an enzyme from a mutant strain of *Bacillus subtilis* was provided to 62 dental patients to evaluate the effect on plaque accumulation. Two groups were formed and both supplied with a medium nylon toothbrush. One group received a tube of the enzyme toothpaste, the other received a placebo. Each group was instructed to brush twice daily, rinsing very little so as to benefit from residual enzyme activity. A beginning examination and prophylaxis was performed. After two weeks a second examination and prophylaxis was done on each group and the placebo and enzyme toothpastes were switched. A final examination was made two weeks later. Measurement of plaque scores was made according to a zero to five scale using disclosing solution. A score of five indicated 100 percent of the tooth surface was coated with plaque. Although no statistical evaluation was mentioned, percentage changes in plaque score indicate a significant retardation when the enzyme toothpaste was used."

MOLLE, W. Efficacy of an enzyme toothpaste in the retardation of dental plaque. J. So. Calif. Dent. A. 9:391-395 Sept. 1967. (Abstracted in J. Western Soc. of Periodontology-Periodontal Abstracts 16:23-24 1968.)

"Data collected during this study suggests that combinations of enzymatic activities of animal origin (dehydrated pancreas) in a chewing gum vehicle retard the deposition of soft accretions, calculus and stain. Further, our findings establish that combinations of enzymatic activities of fungal

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origin are more effective than dehydrated pancreas in retarding the accumulation of similar deposits."

PACKMAN, E.W.; Abbott, D.D.; Salisbury, G.B. and Harrisson, Jos. W.E.  
Effect of enzyme-chewing gums upon oral hygiene. J. Periodont. 34:255-  
258 May 1963.

Article outlines facts on oral hygiene, also requirements, motivations, and problems. Dental floss, Tooth Flox and mouthmirrors recommended. Author states "unwaxed" floss is advised by "top" dentists.

PETERSON, Charles T. Oral hygiene - methods and values. Pakistan Dent.  
Rev. 19:29-32 Jan. 1969.

"Article concerned with solving problems for cleaning interproximal areas and perfecting the oral prophylaxis procedure. New products described: Floxite paper; Floxite Strip; Tooth Flox; Tooth Flox magnifying lighted mirror. Author concludes that if oral prophylaxis has been accomplished, "Tooth Flox" can remove fresh debris conveniently and quickly....Tooth Flox: For patient to maintain daily cleaning of gingival crevice, around contacts, and the between teeth areas where brush does not reach (effective when patient has regular prophylaxis). Tooth Flox has soft bushy tufts on edges and corners, aids in removing soft debris (after meals) from entire interproximal areas including gingival crevice, using only one hand, and so easy and pleasant it becomes a habit."

PETERSON, Charles T. Observations on interproximal cleaning: procedure  
in oral hygiene care. N.Y.J.Dent. 39:56-57 Feb. 1969.

"Harrison published on work done with a proteolytic enzyme containing dentifrice, showing 60 to 70 percent decrease in dental plaque in six months usage.....Desensitizing formulas containing 1.4 percent formalin (Thermodent) and strontium chloride (Sensodyne) have been tested showing frequent success in treating generalized areas of moderate sensitivity, but no significant alteration of cervical sensitivity occurred after 30 to 60 days of daily use.....Ammonia and urea compounds have little status in the current therapeutic dentifrice picture.....Dentifrices incorporating antibiotics have ruled out the use of penicillin due to the possibility of sensitization and the development of resistant strains of bacteria in the mouths of users.....Anti-enzyme dentifrices include a study by Sulser, Fosket and Fosdick in 1958 using dehydroacetate-oxylate and showed a promising beginning.....Anti-enzyme dentifrices included the use of a sodium N-Lauroyl sarcosinate dentifrice (Colgate Gardol formula) and studies varied in results from 17 to 48

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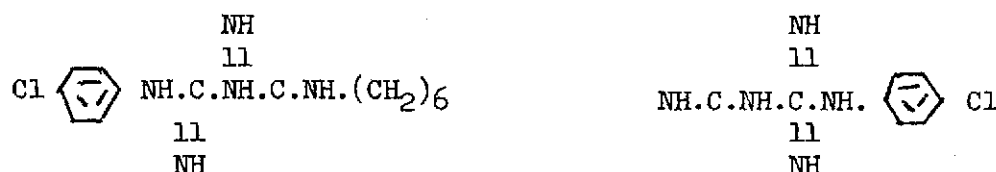
percent effective in periods of from one to two and one-half years..... Fluoride dentifrices have proven difficult to formulate. Amine fluoride dentifrice used on a three year study by Martheler showed a 25 to 32 percent caries decrease.....Stannous fluoride (Crest formula) studies include ten groups and only one was negative. The other tests ranged from 21 to 50 percent reduction in caries incidence."

PETERSON, J. The current status of therapeutic dentifrices. J. Mass. D.S. 15:20 Winter, 1966.

"There is no evidence that chewing gum either reduces or increases caries. There is also no evidence that chewing gum without added therapeutic agents removes debris from the teeth. Chewing gum with or without added therapeutic agents reduces the amount of debris in saliva. Certain enzymes incorporated into chewing gum can retard the accumulation of soft accretions, stain, and calculus on the teeth. Chewing gum with added therapeutic agents (synthetic vitamin K, Nitrofurantoin, chlorophyll, fluoride compounds) may reduce tooth decay, but conclusive proof awaits large scale clinical trials."

RICHARDSON, A.S. and Castaldi, C.R. Current status of chewing gum in preventive dentistry. J. Canadian D.A. 31:713, Nov. 1965.

Chlorhexidine absorbs to hydroxyapatite, tooth surfaces and salivary mucins and is released when concentration in environment is low.



ppt is proteins from saliva and serum.

RÖLLA, Gunnar, Löe, Harald and Schiott, Rindom. The affinity of chlorhexidine for hydroxyapatite and salivary mucins. J. Periodont. Res. 5:90-95, 1970.

".....four students rinsed twice daily with ten ml of a 0.2 percent solution of chlorhexidine gluconate and four students served as controls with a no oral hygiene programme. The number of bacteria in saliva was estimated by a cultural technique and impression preparations were used for the study of the bacteria on the gingiva and tooth surface. Controls showed a 300 percent increase in bacterial counts during the experiment. In the chlorhexidine group the number of bacteria per ml saliva was reduced by 85 percent after 24 hours reaching a 95 percent reduction

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on day five. An 85 to 90 percent reduction was maintained throughout the experimental period. Impression preparations of the gingival area in the controls showed a heavier accumulation of bacteria than in the chlorhexidine group. In addition an increasing bacterial colonization of the tooth surfaces occurred in the controls throughout the experiment, but was never observed in the chlorhexidine group. Although the number of bacteria in saliva was markedly reduced, large numbers still persisted. It therefore appears unlikely that the inhibition of plaque formation is primarily the result of a reduction of the salivary flora. ....Four students rinsed two times daily with a 0.2 percent (10 ml) and four controls on no hygiene program. Numbers of bacteria in saliva counted based on hypothesis that bacteria forming plaque are derived from oral flora. Controls showed 300 percent increase in chlorhexidine group count and decrease of 85 percent after 24 hours reaching 95 percent on day five. Increased to level of control group 48 hours. Gingival impression showed same major types of bacteria but less in chlorhexidine group."

SCHJØTT, C. Rindom; Løe, Harald; Jensen, S. Børglum; Kilian, M.; Davies, R.M. and Glavind, K. The effect of chlorhexidine mouthrinses on human oral flora. J. Periodont. Res. 5:84-89, 1970.

"The allergic response to a toothpaste which was traced to the Ol. Menth. Pip content is recorded. The reaction was in a 67 year old female and presented as massive oedema of the soft tissue around the mandible, neck, throat and floor of the mouth."

SMITH, I. Acute allergic reaction following the use of toothpaste. Brit. Dent. J. 125:304-305, 1968. (Abstract from Periodontal Abstr. J. Western Soc. of Periodontology XVII:14, Mar. 1969.)

"To be of any real aid to the patient, the dentist must do much more than carefully clean and polish the teeth. He must educate the patient to value of the gingival tissues and make sure that he knows how to give them the right kind of care.....The physiologic method is the one which gently cleanses the gingival sulci and massages the investing tissues by permitting the bristles of the brush to travel in the same general direction as the food.....There is nothing more efficient for this purpose (proximal cleaning) than flat dental floss, when used carefully.....Patients who have used the physiologic method of cleaning their teeth for more than 40 years have had no difficulty in retaining the anatomic form and health of the investing tissues."

SMITH, T.S. Anatomic and physiologic conditions governing the use of the toothbrush. J.A.D.A. 27:874 June, 1940.

"1) A supervised, double-blind, clinical study has been conducted to determine the effectiveness of the twice daily use of an antimicrobial mouth rinse containing 0.01 percent CC 10232 (macrolide antibiotic) on dental plaque and calculus formation, and the degree of gingivitis. The clinical study consisted of two groups of 30 dental students. Each group completed same basic clinical design which consisted of an initial oral examination, an oral prophylaxis, and six seven-day treatment phases. Each of the six phases began with an oral prophylaxis and was concluded with an evaluation for plaque, calculus and gingivitis. The six one-week phases were as follows: toothbrushing, use of control or CC 10232 mouth rinse, toothbrushing; toothbrushing, use control or CC 10232 mouth rinse, and toothbrushing. The only difference between the two groups was the particular treatment phase when they utilized either the control or experimental mouth rinses. 3) The results indicate that toothbrushing did not cause a significant improvement in plaque, calculus and gingivitis, when compared to the initial scores. This was due to the relatively high efficiency of the toothbrushing procedure already utilized by these subjects, thus making it extremely difficult to improve upon. 4) The results also indicated that the CC 10232 mouth rinse always produced significantly less plaque, calculus and gingivitis, when compared directly with the control mouth rinse. The reductions (compared to the control mouth rinse) ranged from eleven to 23 percent for dental plaque, from 70 to 91 percent for calculus and from 55 to 72 percent for gingivitis. 5) This clinical study indicates that the most beneficial result in reference to the prevention and/or retardation of plaque, calculus and gingivitis would be obtained by utilizing a program that combined adequate toothbrushing procedures with the use of a 0.01 percent CC 10232 mouth rinse." STALLARD, R.E.: Volpe, A.R; Orban, J.E. and King, W. J. The effect of an antimicrobial mouth rinse on dental plaque, calculus and gingivitis. J. Periodontology-Periodontics 40:683-694 Dec. 1969.

"In a double-blind study, a simple scale was used to grade the amount of disclosed dental plaque accumulated on the facial tooth surfaces of 27 subjects who had used mouthwashes after their toothbrushing. After one week, the use of a commercially available antiseptic mouthrinse, (SCOPE, by P&G) containing domiphen bromide and cetylpyridinium chloride, resulted in a 38 percent decrease in dental plaque formation compared to the placebo rinse. The use of a second test product containing a lower level of cetylpyridinium chloride and no domiphen bromide failed to show an inhibition of plaque."

STURZENBERGER, O.P. and Leonard, G.J. The effect of a mouthwash as adjunct in tooth cleaning. J. Periodontology-Periodontics 40:299-301 May 1969.

"Study conducted to determine whether the chloromethyl analogue of Victamine C reduces the formation of dental plaque considered a precursor of calcu-



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lus. Plaque formation during a three day experimental period was compared in six male dental students, ages 22 to 25, using a test aqueous mouthwash containing Victamine C analogue (0.1% pH 6.0) and a control mouthwash of 0.26 percent aqueous solution of quinine sulfate (pH 6.0).....When employed under the conditions of this study, it reduced the formation of plaque during a three day experimental period. Chloromethyl Victamine C. has also been shown to reduce calculus formation in vivo during eight day and 21 day experimental periods. Although the accumulation of plaque was reduced by the test mouthwash the distribution pattern remained the same as in the controls. Plaque tended to accumulate more on facial surfaces than on lingual surfaces, more on the lingual surfaces of the mandible than the maxilla, and more on posterior teeth than on anterior teeth."

TURESKY, S.; Gilmore, N. and Glickman I. Reduced plaque formation by the Chloromethyl analogue of Victamine C. J. Periodont. 41:41-43 Jan. 1970.

"There exists a general group of therapeutic agents which produce a mild hyperemia. They are called rubefacients and act by causing the release of certain metabolites from the cytoplasm of the cells to cause not only dilatation of functional arteriolas and capillaries in an area but of dormant vessels as well. If such rubefacient could be applied to the gingival tissue, the necessary blood supply would appear to be available when needed.....From the results of this study, it would appear that Stim-U-Dent toothpaste has a rubefacient quality which is at a measurable and statistically significant level."

WEISINGER, E.; Singh, S. and Doyle, J.L. Analysis of purported rubefacient qualities in a new toothpaste. J. New Jersey Dent. Assn. 43:24-25 Sept.-Oct. 1970.

"Bacterial plaque is undoubtedly the most important single aetiological factor in most periodontal disease. A dentist, especially if he practices in the Health Service, cannot afford not to use disclosing agents, as they provide an efficient and dramatic means of teaching the good oral hygiene so important in the prevention of periodontal disease."

WILLIAMS, Gordon L.M. The use of disclosing agents in general practice. Dent. Pract. 16:202-204 Feb. 1966.

"The antiseptic effect of four anesthetic sprays, Carbocain (R), Leostein (R), Pantocain (R) and Xylocain (R) was tested on the oral mucosa of 70 dental students. The experiment was carried out under conditions closely resembling those prevailing under routine injection procedures in the oral cavity. Four test areas and one control area in the buccal fold were used, thereby testing each topical anesthetic 70 times. The number of microorganisms

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found in the needle after insertion through treated and untreated mucosa was used for comparison. The results showed a significant antiseptic effect on all four anesthetics, and were well in accordance with earlier reports. In vitro tests also demonstrated a definite anti-microbial effect of the anesthetics on selected strains of oral microorganisms. It was concluded that the use of anesthetic spray gives an additional advantage of disinfection of the oral mucosa."

WINTHER, J.E. and Praphailong, L. Antimicrobial effect of anesthetic sprays. Acta Odontologica Scandinavica 27:205-218 May 1969.

Total of \$604,240,000.00 spent in 1966 on dentifrices, denture cleansers, toothbrushes, mouth washes and floss. This is \$63 million more than 1965 and \$87 million more than 1964.

AUTHOR UNKNOWN: Publisher's Corner. 1966 public expenditures for oral hygiene products exceed \$600 million. Oral Hygiene 57:8,10 Nov. 1967.

"Thirteen available mouthwashes tested for acidity, foam, bacteria-killing, and odor reducing. Any mouthwash labeled 'antiseptic' or which claims to destroy odor producing bacteria should kill bacteria in 30 seconds..... In summary, samples tested can be separated by groups as follows: VERY GOOD- Cepacol; GOOD - Listerine, Reef, Scope, Sterisol; FAIR TO GOOD - Green Mint, Isodine, Lander's Septine; FAIR - Astring-O-Sol, Micrin; FAIR TO POOR - Lander's Oral Mint, Lander's Oral Care; POOR - Lavis."

AUTHOR UNKNOWN: Mouthwashes - a comparative test. Reprinted from Canadian Consumer Mar.-Apr. 1968. (J. Ontario D.A. 45:227-229 June 1968.)

## X. NUTRITION (effects of diet)

"The theory that dental caries is a deficiency disease which - by the laws of Nature - can be prevented by a complete tooth nutrition was published already in 1948, Aslander (1948). An apparently complete tooth nutrition had then been tried on a small scale - on the writer's children - for ten years with perfect results. Caries-free teeth were grown in an area where 100 percent of the children suffered from dental decay.....It should be noted that the writer's children have been brought up on a very common daily fare, rich in inexpensive carbohydrates. And toothbrushing was restricted to once a day with only water, no tooth pastes at all. Thus it is evident that it was a suitable tooth nutrition, not a selected daily fare - and not even omnipresent dental care - that produced their perfect teeth. ....As suitable food supplement the writer more than 25 years ago adopted a special brand of improved Swedish bone meal.....Our ancestors have been bone-eaters for millions of years with only beneficial results. In properly manufactured bone meal fluorine is preserved in a non-poisonous state, but by an improper processing, for instance by burning off the organic compounds of the bones, the non-poisonous properties are destroyed.....Bone ash has been found to cause fluorine poisoning but proper bone meal is solely beneficial in every aspect. (For vegetarians a suitable mineral food supplement has been composed.) And it should be noted that there is no sign of equality between complete tooth nutrition and the bone-meal method. The bone meal method is only the first attempt to solve the problem of suitable table food supplement. There will be other and - of course - better attempts. But the theory of complete tooth nutrition is a law of Nature and thus eternal."

ASLANDER, Alfred. Correlation between tooth nutrition and dental caries according to the laws of nature. Odontologisk Tidskrift 73:595-612 Mar. 1966.

".....No significant reduction in caries experience or difference in overall oral hygiene status.....However, a significant reduction in calculus was found.....and small proportion of experimental group experienced symptoms of upper respiratory infections....."

AVERILL, Hugh M. and Averill, Jeanne E. The effect of daily apple consumption on dental caries experience, oral hygiene status, and upper respiratory infections. The New York State Dental Journal. 34:403-409 Aug.-Sept. 1968.

"Cocoa powder added to cariogenic diets fed to rats (Kinkel & Newiger, 1960) and hamsters (Stralfors, 1966) decreased the incidence of caries in these animals. According to Stralfors, both water-soluble and insoluble cocoa factors were found to be cariostatic. Unheated or autoclaved five percent concentrations of cocoa inhibited growth of Salmonella species (Busta and Speck, 1968). This study was undertaken to determine the effect of cocoa

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powder on the in vitro growth of the microbial population of saliva. ....A decided decrease in colony growth occurred in the presence of both five percent and ten percent cocoa powder."

BARTELS, Henry A.; Chiat, Leonard A. and Blechman, Harry. Cocoa as a limiting factor on the microbial population of saliva. J.D.Res. 48: 1309 Nov.-Dec. 1969.

"Many factors play a part in the ability of a food to have a cleansing effect. Among these are the consistency of the food, how long the food is chewed and chewing habits of individual. Aside from the water rinses, all the foods tested decreased the debris present. The cleansing effect seems not to be the type of food eaten. Perhaps the action of other elements contribute to the cleansing, such as chewing and swallowing. Using the Debris Index developed by Greene & Vermillion, five so-called abrasive foods and water were tested on twelve subjects to determine the amount of debris actually removed by these foods during eating. The foods tested were celery, apple, carrots, chewing gum, and peanut butter. Virtually no removal of debris (2%) was noted following three vigorous rinsings with water. Chewing gum showed the largest percentage removed with a 52 percent reduction of debris, followed by carrot with 48 percent, apple with 39 percent peanut butter with 36 percent and celery with 31 percent. Most cleansing effects were observed on the buccal or labial surfaces of the teeth rather than in interproximal spaces. Due to the small number of subjects, the evidence is of questionable statistical significance." (Twelve subjects between ages of 20 and 50 selected after staining of debris with disclosing tablet.)

BERDON, John K. The cleansing effect of selected foods on human dentition. Virginia D.J. XLVII:30-35 Oct. 1970.

".....after the age of 20, dentifrices should be chosen not for their putative value for caries prevention, but instead for their effectiveness in combatting periodontal disease.....The trends in social eating, the recommendations of efficiency experts, and even research workers concerned with overweight and heart disease are encouraging increased frequency of eating. As these authorities make their unconscious contributions to increasing decay, dentistry must stand in firm opposition and will have to labor alone in presenting the unpopular case for reducing the frequency of eating.....It is suggested that Dentistry's prevailing teaching on the value of visits to dentist, oral hygiene and diet for the prevention of caries be re-examined to determine whether their emphasis should not be modified."

BIBBY, Basil G. Do we tell the truth about preventing caries? J. Dent. Child. 33:269-279 Sept. 1966.

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"In almost all of the naturally constituted population groups between which comparisons of caries prevalence have been possible there is an association between high caries and high use of sugar. Although this association is suggestive, it does not justify concluding that sugar working alone is responsible for the extent of the caries attack. The lack of parallelism between the available figures on sugar consumption in various countries and their caries records indicates that other factors play a part. If the records on sugar use by various countries accurately reflected the amounts going into other than locally consumed foodstuffs, and also showed the amounts eaten in different forms of solid, semisolid or liquid food mixtures, we could come closer to drawing a meaningful conclusion on the precise role that sugar plays. This, of course, would be true only if more reliable figures on caries prevalence were available for purposes of correlation. Obviously, the final word on the relationship of sugar or other foods to caries causation must await more detailed information on food use and more reliable data on caries prevalence in human population groups."

BIBBY, Basil G. Inferences from natural occurring variations in caries prevalence. J.D.Res. 49:1194-1199 Nov.-Dec. 1970.

"A clinical study was conducted in 474 institutionalized subjects to determine the anticariogenic effect of  $\text{NaH}_2\text{PO}_4$ -enriched ready-to-eat breakfast cereals in subjects who had the same diet and whose cereal consumption patterns were controlled. Results confirm earlier observations that reduction in the incidence of dental caries in both children and adults is associated with the ingestion of  $\text{NaH}_2\text{PO}_4$  enriched cereal. In this study reductions of 48.5 percent and 55.3 percent in the incidence of dental caries in IMF teeth and surfaces, respectively, were observed."

BREWER, Harold E; Stookey, George K. and Muhler, Joseph C. A clinical study concerning the anticariogenic effect of  $\text{NaH}_2\text{PO}_4$ -enriched breakfast cereals in institutionalized subjects: results after two years. J.A.D.A. 80:121 Jan. 1970.

"Perhaps the most substantial contribution to improvement in dental health by reformulation of items of the diet could come about by the substitution of sucrose in many of our foods with some other, less cariogenic, carbohydrate; usually in association with a non-caloric sweetener. I believe the most likely candidates for the role are glucose syrup and glucose itself.....The precise nature of the caries process in humans is only now becoming clear and the experimental techniques necessary to test the possible effect of changes in food formulation are still in their infancy. Progressive food manufacturers are closely involved in this work and look forward to applying it in the future. How quickly they do so will be influenced by professional reaction to the initial efforts already being made."

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BROOK, Maurice Sugar substitutes and their significance for dental health. Dental Health 9:46-52 July-Sept. 1970.

"If you are going to accept the current theory that dental caries is an infectious disease caused by certain microorganisms, then there should be some relationship between the type of diet ingested and the occurrence of caries. Is there any biochemical or experimental evidence to support this opinion: The Vipeholm Study which was done in Sweden is the most comprehensive study on nutrition and caries in human beings. To determine exactly what type of diet was caries-producing, a control group was given a nutritionally balanced diet; and second group, a diet high in protein; a third, a diet high in carbohydrate, and a fourth, a diet high in fat. Children receiving the high carbohydrate diet developed a great amount of dental caries. High protein and high-fat diets were not caries-promoting .....It was recognized by Bodecker in the late 20's and early 30's that streptococci outnumbered lactobacilli on the surface of the tooth and in the dental plaque. In his cultures, from 10,000 to 100,000 streptococci were found for every lactobacillus organism. When the first experiments were done in the early 60's on monobiotic animals (those that were germ-free or infected with just one particular organism), it was found that injecting lactobacilli into a germ-free animal produced no dental caries while infecting these animals with streptococci isolated from tooth surfaces produced caries in every case. This work has been repeated by several groups of investigators and it has been found consistently that caries is caused by streptococci. The microflora and microenvironment of the surface of the tooth can be changed rather rapidly by dietary means. A culture taken from the tooth surface of an individual with a normal diet will reveal a balance between streptococci, lactobacilli and bacteriodes, with streptococci abounding. If the individual is switched to a carbohydrate-free diet, after three or four days, no streptococci can be cultivated from the plaque. Should he reverse back to a carbohydrate-rich diet, the streptococci will regain their ascendancy and again become the most prominent organism....."

CAGNONE, Leroy. Nutrition and dental caries. Contact Point 48:152-155 Mar. 1970.

"The adhesiveness of 77 foods to teeth was measured in an adhesion tester specially designed and constructed for this purpose. The adhesion test involved measurement of the tensile force required to break a bond between food-saliva mixtures and the enamel surface of teeth. It was observed that the effects of surface roughness and organic pellicles on the adhesion of foods to teeth were relatively minor in comparison with the wide range of adhesion for different foods. The volume of saliva incorporated during chewing was fairly constant for each food, even though samples were collect-

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ed from four different subjects, who chewed for widely varying length of time and at different chewing rates."

CALDWELL, Robert C. Adhesions of foods to teeth. J.D.Res. 41:821-832 July-Aug. 1962.

"The possibility exists that the caries-producing potential of certain foods could be reduced by modifying their physical properties. However, few studies that involve human subjects have been conducted to explore the relationship between the physical properties of food (adhesiveness, solubility, viscosity, etc.) as measured by objective procedures and the caries-producing potential of the food. Future research on this subject should involve dental scientists skilled in caries research as well as scientists in the field of food technology."

CALDWELL, Robert C. Physical properties of foods and their caries-producing potential. J.D.Res. 49:1293-1298 Nov.-Dec. 1970.

"When the diet did not contain any carbohydrate, or contained carbohydrate only in small amounts, the teeth were covered by a thin and structureless plaque after a few days. There was only a slight increase in the amount of this plaque during the course of a week. If the diet was supplemented with frequent portions of glucose, the plaque did not significantly differ in amount or appearance from the plaque that was formed when the diet did not contain carbohydrate. On the other hand, considerably larger amounts of plaque was formed if sucrose was consumed instead of glucose."

CARLSSON, Jan and Egelberg, Jan. Effect of diet on early plaque formation in man. Odont. Revy 16:112-125, 1965.

"Thirty-six students participated in an experiment to demonstrate the effect of sucrose upon clinical tooth mobility. Twenty-two subjects (Group I) were instructed to take, under supervision, 100 grams of sucrose (C.P.) daily for four days. This group showed a statistically significant (22.4%) increase in clinical tooth mobility. The 14 students (Group II) serving as a control series had an increase of 8.5 percent in clinical tooth mobility which proved not statistically significant."

CHERASKIN, E.; Ringsdorf, W.M., Jr. and Setyaadmadja, A.T.S.H. Periodontal pathosis in: XIV. Effect of sucrose drinks upon clinical tooth mobility. J. Dent. Med. 20:91-96 July 1965.

"Seventy-six dental students participated in an experiment to demonstrate effects of refined-carbohydrate food and sucrose upon gingival state. The 40 subjects, instructed to take, unsupervised, a relatively low-refined

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carbohydrate high-protein diet, showed a statistically significant (13%) reduction in mean sulcus depth scores in four days. Twenty-two students, receiving 50 gram sucrose supplements twice daily for four days, demonstrated a statistically significant five percent increase in mean sulcus depth. The 14 controls remained essentially the same."

CHERASKIN, E.; Ringsdorf, W.M. and Setyaadmadja, A.T.S.H. Periodontal pathosis in man. XIII Effect of sucrose drinks upon sulcus depth. J. Oral Ther. 2:195-202 Nov. 1965.

"Case report: findings: teeth frequently sensitive to thermal changes; periodontal pathosis including gingival recession; facial pains; loose teeth with shifting; calculus; bruxism. Dietary forms completed and results show inadequate intake of calcium, thiamin, riboflavin, niacin, Vitamin E and B12, methionine, and magnesium.....Record clearly shows that the average dentist does not employ dietotherapy. A major factor is that he has not been taught how to obtain basic dietary information. This report outlines a simple technic for deriving such data."

CHERASKIN, E. and Ringsdorf, W.M., Jr. Why doesn't the dentist use nutritional therapy? Dental Survey 47:29-31 Mar. 1971.

"Studies of the teeth of European children during and after the war indicate that, at least in the countries of Northern Europe, the observed reduction in caries does not exactly parallel the period of reduced sugar consumption, rather the younger children, whose teeth developed during the period of low sugar intake, show a caries reduction in the post war period, when sugar consumption is again high. Their caries experience is closer to that of ancient and medieval skulls which have been studied. The reduction is not due to fluorides included in the diet during the developmental period. Thus all the evidence presented suggests that the structure of the teeth themselves is very important in determining the subsequent caries experience. As yet, no specific substance has been shown to be responsible for the formation of caries-resistant teeth."

CHERASKIN, E. and Ringsdorf, W.M., Jr. Fabric of man. Jrl. of the Am. Soc. for Preventive Dentistry 1:10-17 July-Aug. 1971.

"The authors report dental caries levels in a group of Canadian Eskimo children living in the Keewatin District of the North West Territories. Decay was very prevalent in the primary dentition. This phenomenon may be related to a change of diet and the use of sugar-milk solutions in very young children. A program of preventive dentistry measures is required to raise oral hygiene standards of the Eskimo up to a level consistent with the use of a carbohydrate diet."



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CURZON, M.E.J. and Curzon, Jennifer A. Dental caries in Eskimo children of the Keewatin District in the Northwest Territories. J. Canad. Dental Assn. 36:342-345 Sept. 1970.

"The difference between cariogenic and non-cariogenic diets is not entirely in their sugar or carbohydrate content.....the physical character of foods in the diet is also an important consideration. Caldwell investigated and measured the adhesiveness of 75 foods to tooth surface. Gelatin desserts (58 Gm/cm<sup>2</sup>) and chocolate coated coconut bars (94Gm/cm<sup>2</sup>) showed the least adhesiveness - Carmel showed the greatest adhesiveness(2630 Gm/cm<sup>2</sup>). Wide range of adhesiveness is obvious. Sugar in sticky form caused six times as much caries than sugar in liquid form over a five year period. (Gustafsson, 1954) Food clearance time is important and is linked closely to the adhesive properties of foods. An exception to this is hard candy and chewing gum. These sugars, although not adhesive, have a very long clearance time. Thus in this physical form, sugars can aid in creating and sustaining a caries susceptible environment for a much longer period of time. It is important to note that many foodstuffs which are not in themselves cariogenic, may promote the retention of carbohydrates when ingested along with them."

DAVIS, William. The physical character of food as a dietary factor in dental caries control. The Chronicle of the Omaha Dist. Dent. Soc. 33: 179-180 Feb. 1969.

Radiotelemetric measurements did not confirm Eggers Lura's (1968) opinion that highly concentrated sucrose will lead to an increase in plaque pH.  
de BOEVER, J.; Hirzel, H.C. and Muhlemann, H.R. The effect of concentrated sucrose solutions on pH of interproximal plaque. Helv. Odont. Acta. 13:27-28 Apr. 1969.

"Radiotelemetric measurement of the pH of the interdental plaque exposed for 20 minutes to two modes of continuous application of sucrose were made. The pH dropped to the 4.0 level, but slightly less rapidly than with single sucrose applications. A tendency towards a recovery of pH was not observed either during or up to 40 minutes after application of 10 ml of 40 percent sucrose solutions."  
de BOEVER, J. and Muhlemann, H.R. pH of interproximal plaque with regard to continuous sucrose application. Helvetica Odontologica Acta 13:97-99 Oct. 1969.

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"Presweetened cereals are not necessarily more harmful to childrens' teeth than cereals sweetened from the sugar bowl because both contain sucrose. However, presweetened cereals are more harmful to developing dentition since they are less nutritious and in addition may leave a residual hunger to be filled later with sweets."

DETSCH, Steven G. Presweetened cereals. Dental Student 49;56 Mar. 1971.

"....Merely giving the patient food facts related to the prevention of dental disease does not change his habits. Therefore a personalized approach, based on an organized interview technique, was adopted (at UTDB). Through discussion the patient is enabled to define his own dental-diet problem and helped to discover solutions.....Beginning where the patient is and listening to him, helps establish the rapport critical for patient cooperation. If the interview degenerates into a one-way information session, the effectiveness of communication and patient response are unpredictable.....A five day dietary record serves as essential information for the interview. It aids in patient participation since it focuses clearly on his own eating patterns and food choices."

DIORIO, L.P. and Madsen, K.O. A personalized approach: Discussing food in prevention of dental disease. Nutrition News 33:1 Feb. 1970.

"Over 600 children between six and 18 years of age in residence for nine months of the year at a state institution, were divided into three equal groups of over 200 each. The three dietary additives were fed at the breakfast meal. All children consumed the same basic diet. Supplement I) was a sugar-coated cereal; II) raisins and fruit juices; III) a non-sugar-coated cereal containing approximately 0.4 percent disodium phosphate incorporated into the cereal during processing.....After 18 months, results would indicate that under conditions of study, a sugar-coated cereal does not produce a significant change in dental caries incidence when compared to uncoated cereals or fruits containing natural sugars when eaten once a day in an unrestricted carbohydrate diet."

FINN, Sidney B. and Jamison, Homer The relative effect on dental caries of three food supplements to the diet. I.A.D.R. Abstracts, 1969.

"The results confirm the opinion that milk and sour milk are very slightly acidogenic in the plaques, that beverages containing sugar give a pH-curve very similar to that of sucrose solutions and that natural fruit juices give an acid attack of short duration followed by a period when the pH of the plaques return back to resting values more rapidly than after consumption of sucrose solutions of corresponding strength. However, the natural

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juices gave pH-decreases which were significantly greater than those after milk during the whole experimental period."

FROSTELL, Goran. Effects of milk, fruit juices and sweetened beverages on the pH of dental plaques. Acta Odontologica Scandinavica 28:609-622 Nov. 1970.

"Significantly ( $p < 0.05$ ) lower caries prevalence has been observed in a group of Seventh-Day Adventist school children (132 in group) in comparison with a non-Seventh-Day Adventist group (158 in group) in an area of water-borne fluoride. (Nine to eleven years age of groups) Difference associated with Seventh-Day Adventist recommendations to limit the intake of highly refined carbohydrates (and religious motivation for compliance.)"

GLASS, Robert L. and Hayden Jess Dental caries in Seventh-Day Adventist children. J. Dent. Child. 33:22-23 Jan. 1966.

"It is now well established that sucrose (cane or beet-sugar) is the most cariogenic of the common carbohydrates which have been tested in laboratory animals.....The finding that sucrose was more cariogenic than wheat starch in laboratory rats is in agreement with many earlier results (for example, Shafer, 1949, Gustafson, et al, 1952, Grenby, 1963)."

GRENBAY, T. H. Effects of starch and sugar diets on dental caries. A comparison of two different methods of assessing caries in rodents. Brit. D.J. 128:575-578 June 16, 1970.

"1) The nutritional requirement of a patient is an important factor in determining his response to disease. This requirement may be abnormally high for patients recovering from oral surgery. 2) There are specific indications and contraindications for dietary prescriptions. 3) As currently used, certain therapeutic diets are often deficient in one or more essential nutrients. 4) A therapeutic diet must contain sufficient fluids, calories, proteins, vitamins, and minerals to maintain daily nutritional needs, and compensate for previous and current losses."

HARDING, Jon A. and Davis, Michael J. Nutritional considerations in the treatment of oral disease. Chron. Omaha Dist. Dent. Soc. 34:102-104 Dec. 1970.

"The theory that the harmful effects of the civilized diet are due to its containing less foodstuffs which promote vigorous mastication and a natural cleansing action on the teeth is consistent with the caries incidence and distribution throughout the ages."

HARDWICK, J.L. The incidence and distribution of caries throughout the ages in relation to the Englishman's diet. Brit. Dent. J. 108:9-17 Jan. 5, 1960.

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(Two year trial, 1,506 children, age five to 17 years) "There is an overall reduction of approximately 25 percent in caries increment in the mouths of children eating the treated food and this reduction is mainly demonstrated in the proximal surfaces of posterior teeth which show more than 50 percent less caries. The effect of calcium sucrose phosphates is additional to that noted from fluoridated water. Calcium sucrose phosphates are safe, soluble and readily incorporated in various foods."

HARRIS, Robert; Schamschula, Rezso G.; Beveridge, John and Gregory, Geoffrey  
The cariostatic effect of calcium sucrose phosphate in a group of children  
aged five to 17 years. Aust. D.J. 13:32 1968.

"It is reasonable and practical to control caries in human populations by fortifying selected foods with anticaries agents that are tasteless, colorless, nontoxic and effective. The major action of anticaries agents is on tooth surfaces. The longer an anticaries agent remains on tooth surfaces, the more effective will its action be. Foods, especially sticky and adhesive foods, with long retention times, are, therefore, ideal carriers for anticaries agents in the prevention of caries in human beings. Cereals and cereal products, which are consumed daily by large population groups, and sucrose and candies, which are cariogenic, are examples of the types of foods to be considered for fortification. Fluorides, phosphates and trace minerals are typical of the cariostatic agents that might be added."

HARRIS, Robert S. Fortification of foods and food products with anti-  
caries agents. J.D.Res. 49:1340-1344 Nov.-Dec. 1970.

"Sugar intake classified as refined, natural, and total portions per week were tabulated for 118 patients in a periodontal practice. Depth of proximal periodontal pockets and sulci, sex, age, and missing teeth were recorded and all data were subjected to a stepwise regression analysis computer program. Only two predictors were significant at the five percent level, that is, age of patient and number of missing teeth. The least squares equation indicated that proximal depth measurements decreased as the number of retained teeth increased with advancing age. Generally, however, missing teeth increased with advancing age. No significant correlation between sugar intake and proximal pocket depth was found."

HOFFMAN, Irwin D. and Forsythe, Alan. Portions of sucrose intake as  
related to the average proximal depth measurements of individuals in a  
periodontal practice. Period. Abstracts XVIII:97-99 Sept. 1970.

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"Two hundred twenty-nine Non-Adventist and 156 Adventist teenagers, age 14 to 22 years, were examined in terms of dental caries experience, periodontal and oral hygiene status; diet histories, salivary bacterial counts and toothbrushing frequencies were obtained. The Adventist group showed a lower dental caries experience, but a greater degree of periodontal disease. These differences could not be accounted for by reported toothbrushing frequency, or by salivary bacterial counts, which were essentially the same for each group. The greater degree of periodontal inflammation in the Adventist group can be explained by the more debris and calculus present on the teeth. Therefore, a factor such as the consistency of the diet may be responsible for reducing the efficiency and effectiveness of toothbrushing in the Adventist group.....The Adventist group showed significantly greater mean number of daily servings of fruits and vegetables, and a significantly lower mean number of daily servings of animal protein and carbohydrates in the form of sweets, although the mean number of daily servings of carbohydrates in the form of starches was essentially the same."

HOLMES, Carl B. and Collier, Durward J. Periodontal disease, dental caries, oral hygiene and diet in Adventist and other teenagers. J. Periodont. 37:14-21 Mar.-Apr. 1966.

"Sugar toffees were administered during seven day periods and three day periods to ten subjects. They were without effect on the weights of deposits formed on the lingual of lower incisors as assessed by the standardized foil technique. The deposits, however, were slightly less mineralized. Plaque formation on the labial of lower incisors significantly increased in extent under the influence of sucrose treatment."

KINOSHITA, S.; Schait, A.; Brebou, M. and Muhlemann, H.R. Effects of sucrose on early dental calculus and plaque. Helv. Odont. Acta 10:134-137, 1966.

Total of 210 tests made on ten subjects over three months period. Each subject ate cake of yeast. Two hours later tests run: 1) apple eaten, 2) paraffin chewed 30 minutes, 3) chewy candy eaten, 4) orange slice eaten 5) one stick gum chewed thirty minutes 6) ripe banana eaten, 7) orange eaten with spoon, 8) brush teeth three minutes with paste and rinse. According to these tests, the chewing of apples, sliced oranges and paraffin aided the natural cleansing mechanism to a greater degree than other substances tested. The relatively poor showing of the toothbrush in these tests may be due to the fact that the removal of loose particles from the entire mouth was considered."

KNIGHTON, Holmes T. Effect of various foods and cleansing agents on the elimination of artificially inoculated yeast from the mouth. J.A.D.A. 29:2012-2018, Nov., 1942.

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"From each school in Malmo 60 percent of the seventh form classes were selected at random. From each class those three children with the highest and three with the lowest number of DF surfaces were selected. This gave two groups with 180 children aged 14 years in each. Their parents were interviewed at home according to specially designed questionnaires. No difference was found between groups regarding number of regular meals. Also the frequency of snacks between the meals was the same in the two groups except for consumption of soft drinks and the use of chewing gum which proved to be significantly more common among children with high caries frequency than among those with low caries frequency. As far as the chewing gum is concerned, this difference was more pronounced among girls. Parents of children with high caries frequency and frequent consumption of snacks between meals were not keener on changing the children's dietary habits than were parents of children with low caries frequency, although most of them were well aware of the caries promoting effect of such consumption. It may be assumed that parents are not fully aware what their children eat and drink between meals."

KOCH, Göran and Martinsson, Thore. Socio-odontologic investigation of school children with high and low caries frequency. Odontologisk Revy 22:55-64, No. 1, 1971.

"Results indicate that the exposure to carious attack after ingestion of bread is limited by a rather rapid oral clearance so that frequent intake of this starch product is necessary in order to induce a high caries activity. The observation of a relatively low cariogenicity of bread in comparison with sucrose confirms earlier findings (Grenby, 1967; König, 1967)."

KONIG, K.G. Caries activity induced by frequency-controlled feeding of diets containing sucrose or bread to Osborne-Mendel rats. Arch Oral Biol. 14:991-993 Aug. 1969.

This article covers four general categories of studies: 1) comparison of food use in high and low caries groups. 2) effect of increased carbohydrate intake. 3) effect of decreased carbohydrate intake. 4) effect of vitamin and mineral supplements....and concludes with: "I keep comforting myself with the thought that the reason we haven't found a complete preventive for caries is not that we are stupid, but that it's really a complex disease."

MANDEL, Irwin D. Effects of dietary modifications on caries in humans. J.D.Res. 49:1201-1211 Nov.-Dec. 1970.

"Two age groups, closely supervised boarding school children received apple slices after each meal over a two year period; two test groups

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did not. Every six months gingivitis and caries was evaluated. Table V. shows that two years later the apple group experienced less gingivitis than those of the test groups. Caries attack was also lower, though to a lesser degree. An examination performed after an additional 18 months showed, however, that this advantage had disappeared when regular apple consumption ceased."

MARTHALER, T.M. Apples and oral health. Quintessence International 1:101-104 Mar. 1970.

"The incidence of dental caries among the college students and factory workers was studied. Salivary analysis and dietary data were collected. Calories and nutrients intake of college students and the factory workers in the city of Madras fell short of the minimum requirements. The result of salivary analysis indicated a lower secretion rate and buffer capacity for the caries susceptible group. Dental caries activity is not related to the nutritional adequacy of the diet."

MIGLANI, D.C.; Sujeer, V.N.; Ross, Chadra and Raghupathy, E. Dental caries and its relationship to saliva and diet, Part II. J. Indian Dent. Assn. 42:225-230 Sept. 1970.

Two hundred summer school students - average age 13.9 years, selected at random. 86 boys and 91 girls returned usable questionnaires. Three hundred winter school students - average age 14.5 years - 112 boys, 136 girls returned usable questionnaires. They were given new brush and dentifrice and asked to brush teeth - observed through invisible window so time spent brushing could be observed. Each child interviewed, examined and x-rays taken....."From these data, it appears the majority of children eat more than three times a day and brush less than three times. Repeated ingestion of food will result in substandard diets at mealtime. Dentists can provide an excellent health service by encouraging patients to eat only at meal time."

MUHLER, Joseph C. Frequency of food ingestion - toothbrushing habits and dental caries experiences of freshman high school students. J.A.D.A. 69:738-741 Dec. 1964.

"Author describes apparatus and methods for measuring the rates of diffusion of acid substances into and out of narrow spaces that simulate those found in and between the teeth. Results of his tests indicates that the masticatory function causes rapid entry of sugar into spaces and that the rate of loss of sugar will normally be much slower than the rate of entry. Ingestion of sugar products between meals will decrease diffusion gradients. The carious process is more continuous in

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fissures. Therefore, when evaluating caries control measures, all new caries should be reported in terms of the tooth surface involved."

NEVIN, R.B. The diet and mastication - their effects on diffusion and on the inception of dental caries. (Monograph, Dunedin, New Zealand, Progress Printing Co. Ltd., 1954. 43 pages, 9 illustrations.)

"Certain cariogenic strains of microorganisms possess the ability to synthesize extracellular levans and dextrans from sucrose. Evidence to support the hypothesis that this is the most important property determining cariogenicity is presented.....The intracellular polysaccharide could not contribute, furthermore, to the structural matrix of the plaque in the same way as do the extracellular dextrans and levans. The plaque is made up in part of an acquired cuticle bound to the enamel surface and apparently derived from the saliva. The bulk of the plaque, however, consists of bacteria embedded in a homogenous matrix, which is not salivary in origin but formed by the bacteria themselves. Not only are these extracellular polysaccharides important in enabling cariogenic organisms to colonize on the enamel surface, but they also appear to play a significant role in the periodontal plaque at the gingival sulcus. An aerobic, gram-positive, filamentous bacterium, *odontomyces viscosus*, isolated from subgingival plaque, can cause periodontal disease, when inoculated into uninfected hamsters. In pure culture, *odontomyces viscosus* produces an extracellular levan if grown on a medium containing sucrose or raffinose, but not with arabinose, fructose, galactose, xylose, lactose, maltose, or glucose plus fructose."

NEWBRUN, Ernest Sucrose, the Arch Criminal of dental caries. J. Am. Soc. of Dent. Children 36:23-247 July-Aug. 1969.

"The two food items in human nutrition that are most significant in caries production are fluoride, which inhibits, and sucrose, which increases caries rates."

NIKIFORUK, Gordon. Posteruptive effects of nutrition on teeth. J. D. Res. 49:1252-1261 Nov.-Dec. 1970.

"The question that we are asking is why can't sucrose be enriched with minerals to reduce its cariogenicity without changing its palatability? Why must sugar continue to provide only empty calories? Why not raise its nutritional quality through supplementation? We suggest that an otherwise very cariogenic nutrient could be converted to a cariostatic one if research in mineral fortification of sugar were encouraged and supported. Substituting non-cariogenic snacks seems like the simple, logical answer to the problems, but how does one motivate patients to



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accept non-cariogenic snacks. We must 'understand why' patients select the types of food that they do. General education campaigns have limited value to the individual - only counseling patients on an individual basis will help."

NIZEL, Abraham E. Dental caries: protein, fats and carbohydrates: A literature review. N.Y. Dent. J. 35:71-81 Feb. 1969.

"Though systemic factors may participate, local irritants are largely responsible for the production of chronic periodontal disease. Nutritional deficiency is not an aetiological factor in periodontal disease encountered on the North American continent. Its prevention or treatment by means of nutritional supplements like Vitamin C is therefore unwarranted unless a specific deficiency of the nutrient can be demonstrated."

PARFITT, G.J. and Speirs, D.M. Role of nutrition in the prevention and treatment of periodontal disease. J. Canadian D. Assn. 36:224-227 May 1970.

"Rampant caries of the anterior teeth was observed in 79 children out of 150 attending University College Hospital. Only ten children had sugared dummies or reservoir feeders, and eight of these had rampant caries. Significantly more caries was found in the maxillary incisors and canines, and in the first molars of these children who had a bottle in the cot (sleep). The feeding habit of a 'bottle-in-the-cot' should be strongly discouraged and parents should be advised to wean the child from sugared milk or vitamin supplements prior to the eruption of teeth."

PICTON, D.C.A. and Wiltshire, Pamela J. A comparison of the effects of early feeding habits on the caries prevalence of deciduous teeth. Dent. Practit. 20:170-172 Jan. 1970.

"One hundred fifty-five children, four to nine years of age, were encouraged to eat pieces of raw carrot after their mid-day meal over a two year period. Caries and gingival disease rate and the amount of food debris in these children were recorded at six month intervals and compared with the findings in 191 children of a similar age group attending schools in the same area.....The study failed to demonstrate any marked differences in incidence of dental disease in the two groups, but there would appear to be an increased awareness in the schools of the importance of dental health education."

REECE, J.A. and Swallow, J.N. Carrots and dental health. Brit. D.J. 128:535-539 May 19, 1970.

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"A study of 40 dental students subjected to a diet low in refined carbohydrates with increase in protein, for four days, resulted in a significant alteration in the gingivitis score. The greatest improvement occurred in the group of subjects who, according to biochemical criteria, showed the most unfavorable host state. These data support previous observations with sulcus depth in humans and alveolar bone loss in lower animals."

RINGS DORF, W.M. and Cheraskin, E. Periodontal pathosis in man. II. Effect of relatively high-protein low-refined-carbohydrate diet upon gingivitis. N.Y.St. Dent. J. 28:244-247 June-July, 1962.

"A study of 40 dental students subjected to a diet low in refined carbohydrates with increase in protein for four days resulted in a significant alteration in sulcus depth. The leveling off of mean sulcus depth at about two mm. seems to be in parallel with changes in total serum protein and blood glucose."

RINGS DORF, W.M., Jr. and Cheraskin, E. Periodontal pathosis in man; I. Effect of relatively high-protein low-refined-carbohydrate diet upon sulcus depth. J. Periodont. 33:341-343 Oct. 1962.

"As we believe that prevention is like putting out a fire - you can't do just part of it - we have a separate program for people with minor periodontal problems. This program consists of four appointments of pure Bass-Arnim-Barkley techniques and a Food Intake Study plus Gil Stanton's Vitamin C Therapy. We have found, in a years time, the Vitamin C has stopped the formation of more than 90 percent of the calculus....." Author describes his preventive program and includes:..."She (preventive therapist) then does a Hidden Sugars Evaluation of his (patient's) completed Food Intake Study. Using a glass apothecary jar, she puts one ordinary sugar cube into this jar for each teaspoon of sugar in the patient's diet. In every instance the patient has been amazed, and often appalled, at the amount of sugar he has unknowingly consumed....."

ROSS, B. Warren Prevention power that pays. J. Am. Soc. Prevent. Dent. 1:22-23 July-Aug. 1971.

"Why is it that we sometimes apply all of the above mentioned preventive measures (regular oral prophylaxis, topical fluoride, instructions in good oral hygiene and avoidance of cariogenic foods) and yet the mouth does not improve? We reduced the local destructive factors to the extent of our ability, but we affected only one side of the stress-resistance balance. The solution is obviously to raise the metabolic resistance above the breakdown point. Chemical balance must be achieved and nutrition is the

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key. It is not generally recognized that we have a malnutrition problem in the United States, except for its obvious presence among the poorest classes. We are thought to be the best fed nation in the world. We are no doubt the most fed, but there are many factors in our diet and total environment which reduce our resistance to disease. The longevity of United States men ranks 17th among nations of the world. Subclinical nutritional deficiency is believed to be widespread by several competent investigators. The U. S. Dept. of Agriculture reported that the American diet became worse during 1958-1968. Not only are we deficient in nutrients which are present in man's natural diet, but we also consume synthetic additives and refined carbohydrates never present in natural food."

SPITLER, N. Shreve Don't cure - prevent! J. Academy General Dentistry 17:54-56 Sept. 1969.

"Dental caries is a disease caused by many factors. Altering the factors can change the course of clinical caries. By adjusting the calcium/phosphorus ratio, caries activity can be effectively eliminated in a very short time. This is done through diet.....Diets of 80 caries-inactive and 103 caries-active patients were examined for twelve parameters. No significant differences were found between groups. Nutritional deficiency was not found to be a factor in dental caries. Caries activity correlated with dietary Ca/P ratios. Based on these findings, a hypothesis of caries initiation, phosphate sequestration was developed.....The treatment of caries as a disease, rather than treatment of results of disease, was indicated as feasible."

STANTON, Gilbert Diet and dental caries - the phosphate sequestration hypothesis. N.Y.D.J. 35:399-407 Aug.-Sept. 1969.

"The greatest single cause of dental caries lies in a faulty diet. In order to build up and maintain general health, including caries-resistant teeth, daily diets should supply adequate amounts of protein, vitamins (espec. A,C,D, and E) and minerals, of which the most important macro-elements are calcium phosphorus and magnesium. It is essential that all these nutrients be well balanced, as an excess of the one may cause a deficiency of the other.....Now then, if there isn't the proper quantity and quality of minerals present in the matrix to begin with, and these are only gotten through diet, then all the fluorides in the world couldn't replace or knit more closely together something that isn't there."

STEYNE, Douw G. Fluoridation of public water supplies. Pakistan Dental Review XX:5-27 Jan. 1970.

"Measurements were made of the percentage area on the labial aspects of the maxillary anterior teeth of 31 adults which exhibited plaque stained

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by erythrosin before and after chewing a quarter of an unskinned hard apple. No significant cleansing effect was demonstrated."

WADE, A. Bryan Effect on dental plaque of chewing applies. The Dental Practitioner 21:194-196 Feb. 1971.

"Three methods: 1) half tooth decalcification; 2) solubility of radioactive enamel in bacterial fermentation products; and 3) an enamel surface 'window' technique, were used to test extracts of plant materials for effects on enamel solubility. Using (1) it was found that 15 plant extracts offered a measure of protection against enamel dissolution in pH four lactic acid. With (2) solubility reductions of more than 90 percent were obtained with several herb products. With (3) levels of enamel protection were lower but quite definite. Tests designed to indicate how the extracts modified enamel solubility showed both organic and inorganic agents were involved; in method (2) inhibition of bacterial activity played a large part, and that in (3) where bacterial activity was not involved the enamel protection depended partly on inorganic (buffering) agents and the action of some organic compounds."

WEISS, M.D.; Clarkson, B.H. and Berlin H. Enamel protective factors in foodstuffs. I.A.D.R. Abstracts, 1969.

"Twenty young adult male rats were divided into two groups of ten each and fed either a powder or pellet diet of identical content for 30 days. One hour prior to sacrifice, each rat was given an intraperitoneal injection of 0.5  $\mu$ c of tritiated thymidine per gram of body weight. After sacrifice, the maxillae were dissected out and prepared for autoradiographic and histologic study. Proliferative cellular activity was determined in the periodontal tissues of the maxillary first molars. Significantly higher activity was noted in the crestal epithelium and in the fibroblasts at the interradicular septum of the pellet fed rats when compared to powder fed animals. These elevated values may reflect tissue responses to the coarser consistency of the pellets."

WEISS R; Stahl, S.S. and Tonna, E.A. The effects of diets of different physical consistencies on the periodontal proliferative activity in young adult rats. J. Period. Res. 4:296-299, 1969.

"Sucrose is a specific caries accelerating factor. It was therefore thought worth while to determine the sucrose content of certain high-carbohydrate food products and to assess the tendency of such foodstuffs to form plaque in vitro. The sucrose content was determined from the enzymatic reaction. The tendency to form plaque was judged on glass plates immersed in food-stuff extracts that had been inoculated with Streptococcus mutans and

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incubated for 48 hours at 37° C. Very little sucrose could be demonstrated in ordinary bread. Certain sorts of white bread contained no sucrose at all. Rusks baked with yeast contained no sucrose; buns, only if they were sugar-coated. Cakes and biscuits contained large amounts of sucrose. Corn flakes with sugar or chocolate on the surface contained sucrose, while corn flakes without such coating contained no sucrose. Roasted rice, pop-corns and cheese-crummy contained little sucrose. In all cases there was a direct correlation between the sucrose content and the tendency to plaque formation."

WINHOLT, Anna-Stina Sucrose content and plaque formation in extracts from various food products. Odontologisk Revy 21:301-307, No. 3, 1970.

## CONCLUSIONS AND RECOMMENDATIONS

Results obtained from this report "Effects of a Simulated Spacecraft Environment on the Oral Microflora of Nonhuman Primates" (Part I), indicate that in the marmoset the simulated spacecraft environment, for as long as 56 days, is not a hazard to oral health.

Loss of weight was a consistent finding, while the marmosets were in the simulated space environment. It is believed that this was due to the type of food provided which was different than their usual maintenance diet rather than due to environmental factors. Too, this finding did not appear to affect their oral health.

Whether the information obtained from the marmoset studies will be applicable to humans will depend on the findings obtained during future actual and simulated extended space flights.

It is evident from a review of this collection of abstracts (Part V) that dental caries and periodontal disease can be prevented and controlled when individuals understand the causes of dental disease and practice preventive procedures.

The historical section of this review documents that the information that dental disease is controllable has been available to the profession for many years. It is only recently that dental schools and the more progressive dentists have made concerted efforts to bring this information to their students, patients, and to the public.

This review provides the background information for a program of

prevention and control of dental disease that is applicable to those involved in extended space flights. These recommendations are:

1. Personnel receive information concerning the cause of the two most prevalent of dental diseases, dental caries (tooth decay) and periodontal disease (pyorrhea). Where the cause is understood the reasons why certain preventive procedures are needed is also understood and more cooperation can be expected.
2. The cause of dental disease is the accumulation of bacterial plaque on tooth surfaces and in the space between the tooth and gums. Therefore, personnel should be instructed and supervised on how to remove bacterial plaque until they learn well and should then be checked frequently to determine whether they are continuing to clean well.
3. The most popular aids for cleaning the teeth are soft, rounded-end bristle toothbrush and unwaxed nylon dental floss that have been manufactured according to Bass specifications. However, the patient may have need for additional cleaning aids and should receive instructions in how to use them. Additional aids may include water irrigators, bridge cleaners, tooth picks, etc. Disclosing solutions show where the plaque accumulates and instructions on how it should be used are needed. The tools used for cleaning are not as important as how they are used for cleaning.
4. A complete diet is necessary for good nutrition. Frequent consumption of carbohydrate foods predisposes to conditions favorable for growth

of dental bacterial plaque. Therefore, it is recommended that every consideration be given to the types of food that are consumed during extended missions and the frequency these foods are eaten.

5. The use of topical fluorides is important in the prevention of dental caries. Self application of fluoride containing solutions is practical and may be recommended for individuals susceptible to dental caries. The frequency of application and type of fluoride prescribed should be decided by the dentist.
6. Individuals involved in extended space missions should be free of dental infection and have all restorative work completed. Preventive procedures are not a substitute for needed dental treatment. However, the individual must learn to prevent further disease by practicing good oral hygiene therapy daily.
7. At this time there are no solutions that can be painted on the surfaces of the teeth, no pills that can be taken or injections that provide immunity against dental caries and periodontal disease. The only means of preventing and controlling dental disease is the systematic removal of bacterial plaque from the tooth surfaces and from the spaces between the gum and teeth. This procedure called good oral hygiene is what the patient learns to do and not what the dentist or dental hygienist does for the patient.

At this time it is expected that those involved in space travel can obtain and maintain healthy oral tissues if they understand and practice the principles of prevention of disease. If it is found that the physical and stressful conditions



imposed by extended space flights predispose factors that initiate oral disease then further research in this area will be needed.

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